

IN THE UNITED STATES DISTRICT COURT FOR THE  
NORTHERN DISTRICT OF OKLAHOMA

W. A. DREW EDMONDSON, in his )  
capacity as ATTORNEY GENERAL )  
OF THE STATE OF OKLAHOMA and )  
OKLAHOMA SECRETARY OF THE )  
ENVIRONMENT C. MILES TOLBERT, )  
in his capacity as the )  
TRUSTEE FOR NATURAL RESOURCES )  
FOR THE STATE OF OKLAHOMA, )  
Plaintiff, )  
vs. ) 4:05-CV-00329-TCK-SAJ  
TYSON FOODS, INC., et al, )  
Defendants. )

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VOLUME I OF THE VIDEOTAPED  
DEPOSITION OF BERNARD ENGEL, PhD, produced as a  
witness on behalf of the Defendants in the above  
styled and numbered cause, taken on the 8th day of  
January, 2009, in the City of Tulsa, County of  
Tulsa, State of Oklahoma, before me, Lisa A.  
Steinmeyer, a Certified Shorthand Reporter, duly  
certified under and by virtue of the laws of the  
State of Oklahoma.

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918-587-2878

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## A P P E A R A N C E S

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 (Via phone)

ALSO PRESENT: Dr. Victor Bierman

## I N D E X

## W I T N E S S P A G E

BERNARD ENGEL, PhD

Direct Examination by Mr. George 6

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(Whereupon, the deposition began at  
 9:01 a.m.)

VIDEOGRAPHER: We are now on the Record for  
 the deposition of Dr. Bernard Engel. Today is  
 January 8th, 2009. The time is 9:01 a.m. Would 09:01AM  
 counsel please identify themselves for the Record.

MR. GARREN: Richard Garren for the State  
 of Oklahoma.

MR. GEORGE: Robert George for the Tyson  
 defendants, and I have with me Vic Bierman who is a 09:01AM  
 consultant for the defendants.

MR. McDANIEL: Scott McDaniel for Peterson  
 Farms, Inc.

MR. BASSETT: Woody Bassett for the  
 George's defendants. 09:02AM

VIDEOGRAPHER: And on the phone?

MR. SANDERS: Bob Sanders for the Cal-Maine  
 defendants.

VIDEOGRAPHER: Thank you. The witness may  
 be sworn in.

BERNARD ENGEL, PhD  
 having first been duly sworn to testify the truth,  
 the whole truth and nothing but the truth, testified  
 as follows:

DIRECT EXAMINATION

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1 BY MR. GEORGE:  
2 Q Good morning, Mr. Engel.  
3 A Morning.  
4 Q My name is Robert George. You and I have met  
5 before; correct? 09:02AM  
6 A Correct.  
7 Q Dr. Engel, are you still employed as a  
8 professor at the university of Purdue?  
9 A At Purdue University, yes.  
10 Q And is your work being done in connection with 09:02AM  
11 this lawsuit an official university project or is it  
12 something you're doing separate and apart?  
13 A It's something and apart.  
14 Q Okay. Are you doing it through your  
15 individual capacity or do you have a consulting 09:02AM  
16 company that you provide these services under?  
17 A I do this as an individual.  
18 Q And do you have a staff that has worked with  
19 you on this case?  
20 A I have one individual who has worked directly 09:02AM  
21 with me and probably, as we'll talk about later, I  
22 work with other experts that are part of the team.  
23 Q Okay. Who is the individual that has worked  
24 with you directly on your analysis in this lawsuit?  
25 A Dr. Ji-Hong, J-I, hyphen, H-O-N-G, Jeon, 09:03AM

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1 J-E-O-N.  
2 Q And is he an employee of yours?  
3 A Yes, he had been. So he has been working with  
4 me on a contractual basis.  
5 Q If I refer to him as Dr. Ji-Hong, you know who 09:03AM  
6 we're talking about?  
7 A Yes.  
8 Q Okay. Has Dr. Ji-Hong also been affiliated  
9 with Purdue University?  
10 A He was. He no longer is. 09:03AM  
11 Q Okay. In what capacity was he affiliated with  
12 Purdue University?  
13 A As a post doc.  
14 Q A post doc in what program?  
15 A In ag and biological -- agricultural and 09:04AM  
16 biological engineering.  
17 Q Was Dr. Ji-Hong a student of yours?  
18 A Not a student but a post doctoral associate.  
19 Q Describe for me the relationship between  
20 someone such as yourself, a professor, or a research 09:04AM  
21 professor and a post doc student.  
22 A Sure. A post doc would be someone who has  
23 completed a PhD program, and it would not be unusual  
24 then that someone who has done that might move into  
25 a post doc position, and in that position, they 09:04AM

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1 would tend to work with a professor on a variety of  
2 projects, often numerous projects.  
3 Q How old approximately is Dr. Ji-Hong?  
4 A Probably late 20s.  
5 Q Would it be fair to say that his work for you 09:05AM  
6 as a post doc associate would be his first  
7 professional employment?  
8 A Well, as a graduate student, one is getting  
9 professional experience and is employed, so actually  
10 as a graduate student would probably be the first 09:05AM  
11 professional employment.  
12 Q Had Dr. Ji-Hong not spent time in the private  
13 sector, for example, before becoming a post doc  
14 student?  
15 MR. GARREN: Object to the form. 09:05AM  
16 A No, he had not.  
17 Q Did Dr. Ji-Hong have any teaching  
18 responsibilities at Purdue University?  
19 A No.  
20 Q When did he obtain, if you know, his PhD? 09:05AM  
21 A I'm not positive offhand. I would have to  
22 look at his CV.  
23 Q Did he have his PhD when this lawsuit was  
24 filed in June of 2005?  
25 A To the best of my knowledge, no. 09:06AM

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1 Q But still working towards it to the best of  
2 your knowledge at that time?  
3 A Correct.  
4 Q You said Dr. Ji-Hong was working on a  
5 contractual basis for you. What does that mean? 09:06AM  
6 A So he was performing certain tasks and was  
7 being paid to perform those tasks.  
8 Q Was he being paid by the hour?  
9 A Yes.  
10 Q Okay, and what was his hourly rate? 09:06AM  
11 A \$50 per hour.  
12 Q In order to substantiate his entitlement to  
13 wages, did Dr. Ji-Hong maintain time records or  
14 timesheets that he submitted to you?  
15 A No. So those were conveyed to me orally and 09:07AM  
16 those were then paid.  
17 Q Did you actually write a check to Dr. Ji-Hong  
18 and then seek reimbursement from the plaintiff's  
19 attorneys in this case or was he paid directly by  
20 the law firms? 09:07AM  
21 A I paid him and was reimbursed.  
22 Q You've been paid for your work in this case,  
23 including reimbursement for Dr. Ji-Hong's time, by  
24 the Motley Rice Law Firm out of South Carolina;  
25 correct? 09:07AM

3 (Pages 6 to 9)

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<p>1 that are summarized in the figures in the errata.  2 So those results ultimately changed because of the  3 issue we just talked about.  4 Q Dr. Engel, in describing the mistake that's  5 identified, you used the word code several times. 09:47AM  6 Are you referring to computer code?  7 A Yes. It was computer code.  8 Q Okay, and was this computer code in which the  9 mistake was present, was it part of the GLEAMS  10 computer code or something else? 09:47AM  11 A It was not the GLEAMS computer code. It was  12 code specifically written for this effort for  13 calibration.  14 Q Does this code have a name or description that  15 you can provide me? What program or operation does 09:47AM  16 it relate to?  17 A Calibration.  18 Q Is it -- I've seen something referred to in  19 your report in your materials SCE?  20 A Yes. 09:47AM  21 Q Is it related to that?  22 A Yes, it is.  23 Q What is SCE?  24 A Is shuffled complex evolution.  25 Q And for the Record what is that in terms that 09:47AM</p>	<p>1 peer review in an academic or scientific setting?  2 A Not the specific code that had the error in  3 it, no.  4 Q What about the corrected code because as I  5 understand it, the mistake was identified by Dr. 09:50AM  6 Ji-Hong. He made a programming change; is that  7 right?  8 A Correct.  9 Q Has the corrected code that was used in the  10 modeling work in this case and written by Dr. 09:50AM  11 Ji-Hong been subjected to peer review?  12 A No, but it's not unusual that this -- that  13 this code would not typically be written up for that  14 purpose.  15 Q Well, has that code been used, the specific 09:50AM  16 code been used in any other water quality modeling  17 project that you're aware of?  18 A The specific code, no.  19 Q What was the basis for -- I'm sorry, strike  20 that. What was the scientific basis for the code 09:50AM  21 that was written by Dr. Ji-Hong that was used in the  22 calibration process in this case?  23 A Well, the scientific or conceptual basis was  24 to run the GLEAMS model for each combination of land  25 use soils management, obtain an output, move on to 09:51AM</p>
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<p>1 lawyers can understand?  2 A It's --  3 MR. GARREN: An assumption.  4 A It's not an assumption. It's an algorithm or  5 con -- it's an algorithm of sorts that is often used 09:48AM  6 in calibrating complex models, among other things.  7 Q You stated a moment ago, Dr. Engel, that this  8 particular computer code in which the mistake was  9 present was written specifically for this project;  10 is that right; did I understand you correctly? 09:48AM  11 A Well, the calibration code was, yes.  12 Q Okay, and that's where the mistake was was in  13 the calibration code; correct?  14 A Correct.  15 Q Who actually wrote the calibration code that 09:48AM  16 was used to derive results from the model?  17 A Dr. Ji-Hong.  18 Q Do you know, Dr. Engel, if this calibration  19 code that Dr. Ji-Hong wrote and used in this project  20 has ever been used in another water quality modeling 09:49AM  21 project?  22 A The specific code has not. The concept  23 certainly has.  24 Q So has Dr. Ji-Hong's calibration code that was  25 used in your work in this case been subjected to 09:49AM</p>	<p>1 the next of those in this loop I was describing,  2 obtain an output until one got through running each  3 of these management units or response units.  4 So once having run those, you know, results  5 were summed and a comparison was made with observed 09:51AM  6 phosphorus load data, and based on that comparison,  7 this code then used this SCE, the shuffled complex  8 evolution, concept that was outside of this code  9 with the mistake in it in order to identify and  10 adjust inputs into the GLEAMS model to move 09:52AM  11 predicted phosphorus loads closer to observed  12 phosphorus loads, and so this code would step  13 through this process thousands, tens of thousands of  14 times in identifying a best set of inputs to the  15 GLEAMS model to match the observed phosphorus loads 09:52AM  16 for the calibration period.  17 Q Did Dr. Ji-Hong write any other computer code  18 that was used in the modeling work that you  19 performed in this case?  20 A Certainly there was other code written to, you 09:53AM  21 know, automate various aspects of the analysis.  22 Q And was that other code written by Dr.  23 Ji-Hong?  24 A Yes.  25 Q Okay, and did you review his computer code for 09:53AM</p>

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1 those other operations?  
2 A I didn't look line by line at all the code.  
3 Q You just counted on Dr. Ji-Hong to do it  
4 right; is that fair?  
5 A Well, yes, I relied upon him to write the 09:53AM  
6 code. I reviewed, summarized datasets, you know, to  
7 see if things were making sense.  
8 Q But reviewing that summarized dataset wouldn't  
9 necessarily allow you to identify a mistake in the  
10 code, would it? 09:54AM  
11 A Well, it would typically allow one to identify  
12 major mistakes in codes. In this particular case,  
13 it didn't allow me to identify the mistake in the  
14 code.  
15 Q Is it true, Dr. Engel, that Dr. Ji-Hong is the 09:54AM  
16 scientist, if you will, who actually ran the GLEAMS  
17 model for your work in this case?  
18 A Yes. He was the -- well, yes, he was the one  
19 watching over the computer runs of this.  
20 Q Okay. Did Dr. Ji-Hong also make decisions in 09:54AM  
21 setting up or configuring the GLEAMS model that was  
22 used in this case?  
23 A Can you describe what you mean by setting up  
24 or configuring?  
25 Q Well, Dr. Engel, you'll agree that there are a 09:54AM

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1 multitude of decisions that have to be made in using  
2 any model in an environmental setting; correct?  
3 A Correct.  
4 Q And some of those decisions relate to whether  
5 to use default values, for example, that are 09:55AM  
6 embedded in the programming or manual; correct?  
7 A Yes.  
8 Q The modeler also has the opportunity in  
9 certain instances to adjust values based on site  
10 specific data; correct? 09:55AM  
11 A Correct.  
12 Q Did Dr. Ji-Hong make any decisions regarding  
13 the use of or adjustment of default values used in  
14 the GLEAMS modeling work in this case?  
15 A He would have made those in consultation with 09:55AM  
16 me.  
17 Q Did he consult with you on every decision?  
18 A Not on every decision.  
19 Q Now, this mistake in the computer code that  
20 was developed by Dr. Ji-Hong was only identified 09:55AM  
21 after the defendants asked questions of you  
22 following the issuance of your report; is that  
23 right?  
24 A Yes.  
25 Q Let's go back to Dr. Ji-Hong for a moment. 09:55AM

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1 Other than preparing computer code and working on  
2 the setup of the GLEAMS model and running the GLEAMS  
3 model, what did Dr. Ji-Hong do in support of your  
4 work in this case?  
5 A So could you repeat the -- I think you 09:56AM  
6 mentioned two items that you attributed to him.  
7 Q My understanding is Dr. Ji-Hong participated  
8 in the setup of the GLEAMS model; is that correct?  
9 A Correct.  
10 Q Dr. Ji-Hong also was the person responsible 09:56AM  
11 for actually running the GLEAMS model; is that  
12 right?  
13 A Correct.  
14 Q And Dr. Ji-Hong was the programmer, if you  
15 will, who wrote computer code? 09:56AM  
16 MR. GARREN: Object to form.  
17 Q Is that right?  
18 A Yes, he wrote computer code.  
19 Q Okay. What else did Dr. Ji-Hong do related to  
20 your work in this case? 09:56AM  
21 A He extracted and summarized data from the  
22 model output and provided those summarized data that  
23 I worked with.  
24 Q Dr. Engel, did you ever examine the raw output  
25 data that was generated by the GLEAMS model being 09:57AM

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1 run by Dr. Ji-Hong?  
2 A Some of it.  
3 Q That was not your regular course, though, in  
4 your work in this case; is that right?  
5 A No. I'm sorry. 09:57AM  
6 Q Is that right?  
7 A That was not my regular course.  
8 Q Okay. Thank you. What did Dr. Ji-Hong do in  
9 terms of summarizing the output data or result from  
10 the GLEAMS model prior to your review of that 09:57AM  
11 information?  
12 A Can you explain that further?  
13 Q Describe for me the process that Dr. Ji-Hong  
14 went through to take raw output data and provide you  
15 with summarized data. 09:57AM  
16 A So there were, again, computer codes that were  
17 created to extract and summarize some of those data,  
18 and those data were then, you know, provided to me  
19 as a file or a series of files that I continued to  
20 work with. 09:58AM  
21 Q What information was lost in the summary, if  
22 you will? The summary is, by definition, less  
23 information than you start with.  
24 A Sure. Oh, what is lost? Maybe the best way  
25 for me to describe that would be to describe the 09:58AM

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1	Q Well, I'm not the modeler. What does the	1	Q Okay. Then who made it?
2	model run?	2	A Well, the piece of code that we've talked
3	A Maybe a little bit of context for you. So	3	about in the prior hour was the place where that
4	GLEAMS was being run for each response unit. So if	4	decision was being made.
5	we're counting, you know, a run on each response	5	Q The computer made the decision? 10:16AM
6	unit, then they were being run multiple years,	6	A The computer was making the decision.
7	multiple times during calibration, and then multiple	7	Q Okay. Were all decisions with respect to
8	times for the other scenarios that were ultimately	8	calibration made by the computer code?
9	examined. So if we count each one of those,	9	A Certainly not all, no.
10	probably hundreds of thousands or millions of times	10	Q Some of them were made by the independent 10:16AM
11	that the model would have been run.	11	judgment of the modeler; correct?
12	Q Okay, and how many of those hundreds of	12	A Yes.
13	thousand or millions did you actually --	13	Q Okay, and that independent judgment in the
14	A So --	14	calibration process most often would have been
15	Q Hang on. I'm sorry. Did you actually 10:14AM	15	exercised by Dr. Ji-Hong; is that right? 10:16AM
16	complete as the guy who was at the switch running	16	A No.
17	the model?	17	Q Okay. Let me hand you -- let me go back for a
18	A Well, I wasn't the guy at the switch running	18	second. You said the computer code makes most of
19	the model most of the time.	19	the decisions regarding calibration; right?
20	Q You weren't, okay. That was Dr. Ji-Hong? 10:14AM	20	MR. GARREN: Object to form. 10:17AM
21	A Yes.	21	A Maybe I wouldn't agree with that statement
22	Q Okay. You indicated that perhaps you had some	22	fully, and you want me to explain why?
23	involvement in the running of the calibration runs;	23	Q Sure.
24	is that right?	24	A So the computer code was written by Dr.
25	A Yes. 10:14AM	25	Ji-Hong. The computer code was trying to maximize 10:17AM
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1	Q Okay. As between yourself and Dr. Ji-Hong,	1	the fit or obtain a best fit between the modeled
2	who was more involved in completing the calibration	2	result and the observed data. The computer code had
3	runs?	3	the ability to adjust model inputs within certain
4	A Dr. Ji-Hong.	4	ranges. Those certain ranges were set by myself and
5	Q Okay, and can you describe for the Record, 10:15AM	5	Dr. Ji-Hong. 10:18AM
6	please, what calibration means and what it entails	6	Q Set jointly by the two of you?
7	generally?	7	A Yes.
8	A Yes. So the concept with calibration is you	8	Q Where was Dr. Ji-Hong located when he was
9	have an observed set of data. So in this particular	9	running the model?
10	case, let's pick phosphorus, and you are adjusting	10	A Depends on the time frame. 10:18AM
11	inputs into the model that's trying to predict that	11	Q Well, break it in half, if you can.
12	amount of phosphorus, so you adjust those inputs to	12	A Okay. So in the initial phases of this, he
13	some suitable level such that the model results for	13	was located in West Lafayette at the Purdue
14	phosphorus and in this particular case, matched the	14	University campus. So I believe he departed the
15	observed phosphorus. 10:15AM	15	Purdue campus in late January, early February of 10:18AM
16	Q Who decides what's suitable in terms of how	16	2008.
17	far to turn the dial, if you will, on a calibration?	17	Q Where did he go?
18	A Well, there are different ways to do that.	18	A He took a faculty position at a university in
19	Q In connection with the work in this case, and	19	South Korea.
20	I understand that Dr. Ji-Hong was the person who was 10:16AM	20	Q What university? 10:19AM
21	performing the calibration physically, would Dr.	21	A Andong I believe, A-N-D-O-N-G.
22	Ji-Hong be the one who made the decision as to how	22	Q Where is Andong University located in South
23	far to turn the dial, if you will?	23	Korea, if you know?
24	MR. GARREN: Object to form.	24	A I'm not sure which city it would be in or
25	A No. 10:16AM	25	near. I don't recall. 10:19AM

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<p>1 Q And was the GLEAMS model actually loaded onto,</p> <p>2 if you will, a computer?</p> <p>3 A Yes, it would have to be, yes.</p> <p>4 Q You load it on a laptop computer?</p> <p>5 A Generally it was on a -- the files were stored 10:19AM</p> <p>6 on a server.</p> <p>7 Q Who owned the server?</p> <p>8 A Let's see. So the server would have been a</p> <p>9 Purdue University server.</p> <p>10 Q Okay. Did Dr. Ji-Hong take the files, the 10:20AM</p> <p>11 electronic files with him to South Korea when he</p> <p>12 left in January or February of 2008?</p> <p>13 A He had access to the server.</p> <p>14 Q Access through the Internet?</p> <p>15 A Yes. 10:20AM</p> <p>16 Q Okay. The running of the model, whether it be</p> <p>17 in a scenario or a calibration setting, was still</p> <p>18 occurring after February of 2008 when Dr. Ji-Hong</p> <p>19 went to South Korea; is that correct?</p> <p>20 A Correct. 10:20AM</p> <p>21 Q So some of the modeling work that Dr. Ji-Hong</p> <p>22 completed in support of your report in this case was</p> <p>23 done while he was located in South Korea; is that</p> <p>24 right?</p> <p>25 A Yes. 10:20AM</p>	<p>1 Ji-Hong have had some difficulty communicating</p> <p>2 because of the language barrier?</p> <p>3 MR. GARREN: Object to form.</p> <p>4 A Yes.</p> <p>5 Q Now, would you be on the phone with Dr. 10:22AM</p> <p>6 Ji-Hong while he was running the model the whole</p> <p>7 time?</p> <p>8 A Certainly not the whole time.</p> <p>9 Q Okay. Let me hand you what we'll mark as</p> <p>10 Exhibit 3 to your deposition, which for the Record 10:23AM</p> <p>11 is an E-mail chain that began from me to Mr. Page</p> <p>12 July 12 of 2008 and ends with you being brought into</p> <p>13 the conversation by Mr. Page in an E-mail dated</p> <p>14 August 12th of 2008. Do you see that?</p> <p>15 A Yes. 10:23AM</p> <p>16 Q And you see, Dr. Engel, that in July of 2008,</p> <p>17 I have asked a series of questions related to the</p> <p>18 GLEAMS modeling, including some related to the</p> <p>19 calibration runs?</p> <p>20 A Yes. 10:24AM</p> <p>21 Q Okay, and there was some time that passed, and</p> <p>22 then I followed up with Mr. Page, and ultimately a</p> <p>23 set of steps for the -- how the model was calibrated</p> <p>24 was produced, and I believe that is attached. Do</p> <p>25 you see it? 10:24AM</p>
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<p>1 Q Were all of the model runs that were</p> <p>2 ultimately used in your report with respect to</p> <p>3 GLEAMS completed by Dr. Ji-Hong in South Korea?</p> <p>4 A I don't believe so. I believe there were --</p> <p>5 as I recall, the hydrology was -- we had completed 10:21AM</p> <p>6 calibration of that prior to his departure.</p> <p>7 Q What about all the nutrient simulations?</p> <p>8 A I believe we were calibrating. So we were</p> <p>9 calibrating nutrients and started that process prior</p> <p>10 to his departure. That continued once he left. 10:21AM</p> <p>11 Q Okay. How did you and Dr. Ji-Hong communicate</p> <p>12 with one another after he went to South Korea and</p> <p>13 continued to work on the modeling in this case?</p> <p>14 A Typically by phone or Skype.</p> <p>15 Q Phone or what? 10:22AM</p> <p>16 A The Skype. It's Internet phone sort of --</p> <p>17 Q You ever have E-mail communication with Dr.</p> <p>18 Ji-Hong?</p> <p>19 A Not about this.</p> <p>20 Q Is he just not an E-mailer? 10:22AM</p> <p>21 A Not a big E-mailer.</p> <p>22 Q Do I understand that Dr. Ji-Hong's English is</p> <p>23 perhaps -- is perhaps not proficient?</p> <p>24 A That would be a reasonable characterization.</p> <p>25 Q And is it in fact true that you and Dr. 10:22AM</p>	<p>1 A Yes.</p> <p>2 Q Very last page of Exhibit No. 3. What's the</p> <p>3 date of those -- the written document steps for P</p> <p>4 calibration?</p> <p>5 A Looks like that says 8-12-08. 10:24AM</p> <p>6 Q Why did it take, if you know, Dr. Engel, a</p> <p>7 little over a month for me to get answers to my</p> <p>8 questions regarding calibration?</p> <p>9 A Looks like there was a response earlier than</p> <p>10 that; correct? 10:25AM</p> <p>11 Q Partial response, yes.</p> <p>12 A So, yes, there was a partial response prior to</p> <p>13 that and, as I recall, it took a while to get Dr.</p> <p>14 Ji-Hong tracked down and firm up the rest of those</p> <p>15 details. 10:25AM</p> <p>16 Q Okay. Fair to say that part of the delay was</p> <p>17 because Dr. Ji-Hong, according to your E-mail of</p> <p>18 August 12th, was on vacation; is that right?</p> <p>19 A Yes.</p> <p>20 Q And you needed to collaborate with him, as I 10:25AM</p> <p>21 understand it, on exactly what were the steps in the</p> <p>22 P calibration; is that right?</p> <p>23 A Yes.</p> <p>24 Q Okay. So, Dr. Engel, you needed input from</p> <p>25 and confirmation from Dr. Ji-Hong in order to write 10:25AM</p>

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<p>1 up the, oh, one-quarter page summary on calibration 2 that's attached to this E-mail; is that right? 3 MR. GARREN: Object to form. 4 A Yes. 5 Q Okay. Now, let's focus on the steps for P 10:26AM 6 calibration for a moment, which is the last page of 7 Exhibit No. 3. The third paragraph says that the 8 GLEAMS files were manually modified. Do you see 9 that? 10 A Yes. 10:26AM 11 Q That sounds different than this automated, 12 computer-driven calibration you were talking about 13 earlier. What is manual modification in the context 14 of calibration? 15 A So following the automated calibration piece, 10:26AM 16 there were minor modifications that were done to 17 some additional model inputs to better match things 18 across years. 19 Q Okay. What inputs were modified manually? 20 A I don't recall which ones specifically, but 10:27AM 21 the list of potential inputs that were modified 22 would be found in Appendix D, I believe. 23 Q Well, look at the last page of Exhibit 3. Do 24 you see in that third full paragraph after the 25 reference to manual modification it says, by 10:27AM</p>	<p>1 match between the phosphorus across years, so it was 2 one that was sensitive that would allow that. 3 Q Did he try other parameters first before 4 settling on the labile phosphorus concentration? 5 A I assume he would have. 10:29AM 6 Q Well, do you know? 7 A I don't recall at this point. Without 8 discussing that with him further, I don't recall. 9 Q To what extent did he modify the labile 10 phosphorus concentration in the soil as part of 10:29AM 11 calibrating the GLEAMS model? 12 A Well, we could probably look at those files 13 and determine that. 14 Q Well, do you know how substantial the 15 modification was? 10:29AM 16 A Not without looking at the files. 17 Q Where would I go to identify the file that 18 would answer that question? 19 A It would be more than one file. 20 Q What are the names of those files? 10:29AM 21 A Without looking at a file structure and 22 digging through all of these files, I'm not going to 23 be able to sit here and give you a specific file. 24 Q Okay. What were the factors or the rationale 25 employed by Dr. Ji-Hong in determining the extent of 10:30AM</p>
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<p>1 modifying li -- how do you say that; labile? 2 A Labile. 3 Q Labile phosphorus concentration in the soil 4 horizon; do you see that? 5 A Yes. 10:27AM 6 Q What is labile concentration for phosphorus in 7 the soil concentration horizon; what does that mean? 8 A So this would be the phosphorus that is most 9 available to become part of runoff. 10 Q Is that an important input parameter in 10:27AM 11 predicting runoff with GLEAMS? 12 A Yes. 13 Q Okay, and that input parameter was manually 14 modified as opposed to being modified by the 15 computer during the calibration process; right? 10:28AM 16 A It would have been modified by the computer 17 during the automated portion of the process and 18 apparently further modified by hand following that 19 process. 20 Q And whose hand further modified that? 10:28AM 21 A That would have been Dr. Ji-Hong. 22 Q Why did he select that particular input 23 parameter for manual modification? 24 MR. GARREN: Object to form. 25 A This particular parameter allowed a better 10:28AM</p>	<p>1 modification to this particular input parameter that 2 was necessary in the calibration? 3 MR. GARREN: Object to form. 4 A Could you restate that or have it read back? 5 MR. GEORGE: Let's have it read back. 6 (Whereupon, the court reporter read 7 back the previous question.) 8 (Whereupon, a discussion was held off 9 the Record.) 10 A So prior to any calibration, there was a range 10:30AM 11 of a potential values that have been identified and, 12 you know, adjustments would not have gone outside 13 that bound. 14 Q Well, those ranges were set in the automated 15 calibration program; correct? 10:31AM 16 A Correct. 17 Q And what were the ranges that were allowed for 18 modification manually after running that automated? 19 A They would not have been beyond the original 20 bounds. 10:31AM 21 Q Well, if the computer had the discretion to 22 adjust that parameter to that extent in the 23 automated process, why would there be a need for a 24 manual modification after that's run? 25 MR. GARREN: Object to form. 10:31AM</p>

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<p>1 A So the idea here was that, you know, the</p> <p>2 automated calibration had a specific set of goals in</p> <p>3 calibrating that was not necessarily looking at how</p> <p>4 the model performed across years, across all years,</p> <p>5 and so the goal in this further adjustment of the 10:32AM</p> <p>6 labile phosphorus was to, you know, have it match</p> <p>7 better across years, better match the yearly</p> <p>8 pattern.</p> <p>9 Q Is it fair to say, Dr. Engel, if I want to</p> <p>10 know why this particular parameter was modified and 10:32AM</p> <p>11 the extent to which it was modified and what</p> <p>12 rationale went into that decision, that I would need</p> <p>13 to talk to Dr. Ji-Hong?</p> <p>14 MR. GARREN: Object to form.</p> <p>15 A No. One could look at the underlying files 10:32AM</p> <p>16 and see how it's modified.</p> <p>17 Q Will that tell me the basis for his rationale</p> <p>18 for his decision to modify it?</p> <p>19 MR. GARREN: Object to form.</p> <p>20 A The discussion I had with him, and as I 10:33AM</p> <p>21 understand, the adjustment then was it was made to</p> <p>22 better match the yearly trends.</p> <p>23 Q Are the modified values that Dr. Ji-Hong</p> <p>24 settled on for labile phosphorus concentration in</p> <p>25 the soil consistent with actual or expected labile 10:33AM</p>	<p>1 calibration program?</p> <p>2 A Boy, I don't recall at the moment.</p> <p>3 Q Was it the same range for every input</p> <p>4 parameter?</p> <p>5 A No. 10:34AM</p> <p>6 Q Are those ranges set out in your report</p> <p>7 anywhere?</p> <p>8 A Oh, I don't know if they're described in</p> <p>9 Appendix D or not. I don't see that they're</p> <p>10 described. The ranges don't seem to be described in 10:35AM</p> <p>11 this appendix.</p> <p>12 Q Let me refer you to page D-20 of your expert</p> <p>13 report dated May 22nd, 2008. Do you see in the</p> <p>14 second paragraph under calibration there is a</p> <p>15 reference to the optimization range was set at plus 10:36AM</p> <p>16 or minus 50 percent of the estimated values?</p> <p>17 A Yes.</p> <p>18 Q Is that related to the range discussion that</p> <p>19 we were having?</p> <p>20 A So that would have been -- yes, that would 10:36AM</p> <p>21 have been the range.</p> <p>22 Q So in the automated calibration program, an</p> <p>23 input variable can be adjusted by the computer to</p> <p>24 plus or minus 50 percent; right?</p> <p>25 A Yes. 10:36AM</p>
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<p>1 phosphorus soil concentrations in the watershed?</p> <p>2 A They would be, yes.</p> <p>3 Q How do you know that?</p> <p>4 A The range that was used was within expected</p> <p>5 ranges. 10:33AM</p> <p>6 Q What was the expected range?</p> <p>7 A Again, I would have to look at a lot of this</p> <p>8 underlying data to see that.</p> <p>9 Q Have you gone back and compared the manual</p> <p>10 modifications made by Dr. Ji-Hong to determine and 10:33AM</p> <p>11 satisfy yourself that the modifications were</p> <p>12 consistent with the environmental conditions in the</p> <p>13 watershed?</p> <p>14 MR. GARREN: Object to form.</p> <p>15 A They were within the ranges that we had set 10:34AM</p> <p>16 ahead of time, so yes, they would be consistent.</p> <p>17 Q You're confident, Dr. Engel, that Dr. Ji-Hong</p> <p>18 did not exceed in his manual modification the limits</p> <p>19 that you established in your automated automization</p> <p>20 -- automated calibration process? Sorry. 10:34AM</p> <p>21 A Yes.</p> <p>22 Q Have you gone back and checked that?</p> <p>23 A Not -- I've not looked at that recently.</p> <p>24 Q What was the range that was established for</p> <p>25 adjustment of these parameters by the automated 10:34AM</p>	<p>1 Q Okay, and is it your testimony, Dr. Engel,</p> <p>2 that in making the manual modifications that Dr.</p> <p>3 Ji-Hong performed as part of the calibration</p> <p>4 process, that you're confident that he stayed within</p> <p>5 that same range of plus or minus 50 percent? 10:36AM</p> <p>6 A Yes.</p> <p>7 Q If he went outside of that range, that would</p> <p>8 be a breach of protocol; is that right?</p> <p>9 A Yes.</p> <p>10 Q How is the plus or minus 50 percent as a range 10:37AM</p> <p>11 for the computer to adjust the input parameters</p> <p>12 established?</p> <p>13 A That would be a fairly typical range in</p> <p>14 watershed modeling.</p> <p>15 Q Can you point me to any treatise or piece of 10:37AM</p> <p>16 peer-reviewed literature that establishes that plus</p> <p>17 or minus 50 percent is the appropriate range for</p> <p>18 optimization in a watershed model?</p> <p>19 A I would have to look through some of those to</p> <p>20 find you one again. 10:37AM</p> <p>21 Q Well, did you derive this from a particular</p> <p>22 treatise or piece of literature?</p> <p>23 A I'm not sure it was derived from a particular</p> <p>24 one, but this is a value that's commonly reported</p> <p>25 when such values are reported. 10:38AM</p>

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1	Q How did you determine that plus or minus 50	1	that's great. If not, E-mail and phone number would
2	percent optimization was appropriate for the	2	be fine.
3	calibration of the GLEAMS model used and applied to	3	A Okay.
4	the Illinois River watershed?	4	Q Let me hand you what we'll mark as Exhibit 4
5	A Well, certainly I have a significant amount of 10:38AM	5	to your deposition, which for the Record is a copy 10:41AM
6	experience with the model, and based on those	6	of an errata report issued and signed by you
7	experiences in other settings, that was a typical	7	on September 4th of 2008. Do you recognize that
8	range.	8	report, Dr. Engel?
9	Q Did you review any data from the Illinois	9	A Yes.
10	River watershed to determine that that's an 10:38AM	10	Q And this was issued four and a half months 10:41AM
11	appropriate optimization range for your work in this	11	after your original report; is that right?
12	case?	12	A Approximately.
13	MR. GARREN: Object to form.	13	Q Okay. It was issued, as I understand it,
14	A What do you mean by any data?	14	after you had identified the error by Dr. Ji-Hong in
15	Q Any environmental sampling data to determine 10:38AM	15	some modeling code in response to questions posed by 10:42AM
16	the extent of variability in the watershed.	16	the defendants; is that right?
17	A I certainly reviewed ample data for the	17	A Correct.
18	watershed, and my judgment was that based on	18	Q Dr. Engel, does Exhibit 4, your September 4th,
19	experiences with the model, based on the literature,	19	2008, errata report correct all of the mistakes or
20	that this is a typical range for use in calibration. 10:39AM	20	errors that were present in your report dated May 10:42AM
21	Q So the plus or minus 50 percent is based upon	21	22nd of 2008?
22	your experience as opposed to any particular	22	A It did, but in the process of correcting
23	analysis related to this watershed; is that fair?	23	those, a new one was introduced.
24	MR. GARREN: Object to form.	24	Q Okay. So there are still errors in your
25	A Well, you know, examining the various data for 10:39AM	25	September 4, 2008 report; is that right? 10:42AM
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1	this watershed and seeing the variability in the	1	A There are some, yes.
2	watershed, variability in the data, this was a	2	Q Okay. Can you identify those for me?
3	suitable range.	3	A So Table 10 and Figure 10.1.
4	Q Did you perform any statistical analysis to	4	Q Can you give me a page number, please?
5	arrive at that conclusion or is it just judgment? 10:39AM	5	A Page number where? 10:43AM
6	A It's my professional judgment.	6	Q At the bottom of the amended report.
7	Q Do you agree, Dr. Engel, that manual	7	A Okay, sorry.
8	modification as part of the calibration process can	8	Q That's okay.
9	introduce bias into the model?	9	A Would be Page 4.
10	A It can. 10:40AM	10	Q Page 4. You said Table 10.1? 10:43AM
11	Q How could I get in touch with Dr. Ji-Hong?	11	A Table 10.1, yes.
12	A Probably call him.	12	Q Was that the only table in which there were
13	Q Do you have his phone number?	13	errors that you have discovered in your September
14	A I may not have that with me.	14	4th report?
15	Q I assume you have it in some contact 10:40AM	15	A Just a moment. If I can, let me look at the 10:43AM
16	information either in your office or on your phone;	16	subsequent errata to make sure I don't mislead you.
17	is that right?	17	Q Please do.
18	A I would, yes.	18	A Did the copy you handed me earlier include the
19	Q Would you have it on your cell phone?	19	errata?
20	A I don't think it's on my cell phone right now. 10:40AM	20	Q Did not. 10:44AM
21	Q Do you know Dr. Ji-Hong's E-mail address?	21	A So this is a memory test? So the other
22	A Again, I would have to look that up as well.	22	impacted table was Table 12 that was part of
23	Q I'm going to ask you, Dr. Engel, to look over	23	Appendix D, which is on Page 48 of the errata.
24	lunch and see if you can find and provide us with	24	Q Okay. Let's start with Table 10.1 on Page 4
25	some contact information. If you have an address, 10:41AM	25	of your September 4th errata report. What 10:45AM

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<p>1 information in that table is inaccurate?</p> <p>2 A Well, it would be the last column identified</p> <p>3 as observed total P load pounds.</p> <p>4 Q And there are within that column ten values;</p> <p>5 do you see that? 10:45AM</p> <p>6 A Yes.</p> <p>7 Q All right. Are all ten of those observed</p> <p>8 total P load values incorrect?</p> <p>9 A I believe the first one is correct, and I</p> <p>10 believe it's the next nine. So without looking 10:46AM</p> <p>11 at -- well, I can look in this and tell you for</p> <p>12 sure. So the first one was correct. The next nine</p> <p>13 were incorrect.</p> <p>14 Q Now, Dr. Engel, did you discover this error in</p> <p>15 your second report, your September 4th, 2008 report, 10:46AM</p> <p>16 in Table 10.1 on your own or was it identified to</p> <p>17 you by someone else?</p> <p>18 A As I recall, you asked a question about that</p> <p>19 or someone had asked a question through you, through</p> <p>20 David Page that, you know, made us identify that. 10:47AM</p> <p>21 Q Okay. Let me hand you what we've marked as</p> <p>22 Exhibit 5 to your deposition, which for the Record</p> <p>23 is an E-mail chain that began with me on October</p> <p>24 15th of 2008, and you're brought into the</p> <p>25 conversation the same day by Mr. Page. Do you 10:47AM</p>	<p>1 A Correct.</p> <p>2 Q Now, if you look at the E-mail that I handed</p> <p>3 you that is marked Exhibit 5, you say to Mr. Page</p> <p>4 with reference to my question, that you figured this</p> <p>5 out; do you see that? 10:49AM</p> <p>6 A Yes.</p> <p>7 Q Okay. What did you figure out?</p> <p>8 A Well, I figured out that I had pasted the</p> <p>9 wrong observed phosphorus loads into a spreadsheet.</p> <p>10 Q Okay. Did you actually complete that pasting 10:49AM</p> <p>11 procedure that resulted in the mistake or did</p> <p>12 someone else do it?</p> <p>13 A That was me.</p> <p>14 Q Now, the figure that is beneath Table 10.1,</p> <p>15 it's Figure 10.1; do you see that? 10:49AM</p> <p>16 A Yes.</p> <p>17 Q Is that figure correct?</p> <p>18 A In the September 4 errata, no, because it's</p> <p>19 simply graphing the last two columns of Table 10.1.</p> <p>20 Q Okay. So this mistake that you made in 10:50AM</p> <p>21 handling the data resulted not just in a table that</p> <p>22 was incorrect but a figure in a reported</p> <p>23 relationship between observed and predicted loads</p> <p>24 that was incorrect; is that right?</p> <p>25 A Correct. 10:50AM</p>
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<p>1 recognize that E-mail?</p> <p>2 A Yes.</p> <p>3 Q And you see in the initial E-mail that I have</p> <p>4 asked a question regarding Table 10.1 in the</p> <p>5 observed total phosphorus loads? 10:47AM</p> <p>6 A Yes.</p> <p>7 Q Is that question what prompted you to discover</p> <p>8 there was a mistake in your report?</p> <p>9 A Correct.</p> <p>10 Q Why didn't you discover it on your own? 10:48AM</p> <p>11 A Well, it was right in the original report, and</p> <p>12 in preparing the errata for -- that was submitted</p> <p>13 September 4th, an error was made in cutting and</p> <p>14 pasting values out of a file, and so the incorrect</p> <p>15 ones were inadvertently inserted in a spreadsheet. 10:48AM</p> <p>16 Q Okay. Dr. Engel, were you careful when you</p> <p>17 put together the September 4th, 2008 errata which</p> <p>18 was designed to correct mistakes in your prior</p> <p>19 report?</p> <p>20 A Yes. 10:48AM</p> <p>21 Q Okay. You were intending to present</p> <p>22 information that was accurate; is that right?</p> <p>23 A That was my intent.</p> <p>24 Q And, nevertheless, you made a mistake;</p> <p>25 correct? 10:49AM</p>	<p>1 Q Dr. Engel, why is it you only seem to discover</p> <p>2 mistakes in your work when the defendants ask</p> <p>3 questions?</p> <p>4 MR. GARREN: Object to form.</p> <p>5 A I guess there was not a reason to be 10:51AM</p> <p>6 rereviewing all the underlying data after the report</p> <p>7 had been submitted.</p> <p>8 Q Well, what about, what procedures did you have</p> <p>9 in place leading up to the issuance of a report that</p> <p>10 was going to be used in a court case to avoid 10:51AM</p> <p>11 mistakes such as those that have been identified?</p> <p>12 A Well, certainly data were reviewed, and it</p> <p>13 intended to be summarized data that were reviewed</p> <p>14 throughout the entire process, but realized that</p> <p>15 there are tens of thousands, if not more, files with 10:51AM</p> <p>16 data in them.</p> <p>17 Q Are there any other mistakes in your two</p> <p>18 reports, the one dated May 22nd and the one dated</p> <p>19 September 4th, that you simply haven't identified</p> <p>20 because the defendants haven't asked a question 10:51AM</p> <p>21 about them yet?</p> <p>22 MR. GARREN: Object to form.</p> <p>23 A I'm not aware of any additional mistakes.</p> <p>24 Q You mentioned that another table or figure</p> <p>25 that was in error in your errata report dated 10:52AM</p>

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<p>1 September 4th is Table 12 on Page 48; correct?</p> <p>2 A Table 12 is the other table that was</p> <p>3 incorrect.</p> <p>4 Q Okay. What is incorrect about Table 12 in</p> <p>5 your September 4th report? 10:52AM</p> <p>6 A So Table 12 relied upon the detailed data that</p> <p>7 were summarized in Table 10.1, and the mistake made</p> <p>8 in cutting and pasting the wrong observed load data</p> <p>9 into a spreadsheet that resulted in the mistake in</p> <p>10 Table 10.1 and Figure 10.1 also impacted an 10:52AM</p> <p>11 automated calculation that is reported in Table 12.</p> <p>12 Q Are each of the six values reported in Table</p> <p>13 12 incorrect?</p> <p>14 A Oh, without seeing the second errata, my</p> <p>15 recollection is that some of those stayed the same. 10:53AM</p> <p>16 Q Okay. Let's go back to the general purpose of</p> <p>17 the September 4th, 2008 report, Dr. Engel. Do I</p> <p>18 understand correctly that the intent of that report</p> <p>19 was to correct mistakes in your prior report; is</p> <p>20 that right? 10:53AM</p> <p>21 A Yes.</p> <p>22 Q Okay, and Exhibit No. 4, your September 4th,</p> <p>23 2008 report, is 48 pages long; is that right?</p> <p>24 A Maybe 49 if you count the cover page.</p> <p>25 Q Okay, and with the exception of perhaps the 10:53AM</p>	<p>1 applied in the watershed for the next hundred years,</p> <p>2 the phosphorus loads to Lake Tenkiller will increase</p> <p>3 in the next 30 years and then become stable for the</p> <p>4 following 70 years. Is that a fair summary?</p> <p>5 A Yes. 10:56AM</p> <p>6 Q Do you stand by that prediction or opinion</p> <p>7 today?</p> <p>8 A Yes.</p> <p>9 Q Okay. Now, that's not the opinion you offered</p> <p>10 in May of 2008 based upon a different model run, is 10:56AM</p> <p>11 it?</p> <p>12 A I believe the -- let me look at that statement</p> <p>13 and make sure I don't misspeak.</p> <p>14 Q I believe it's on Page 2 of your original</p> <p>15 report. 10:57AM</p> <p>16 A I believe the differences in the statements is</p> <p>17 that declined slightly has been removed in that</p> <p>18 statement.</p> <p>19 Q So you're not offering the same opinion in</p> <p>20 your September report that you were offering back in 10:57AM</p> <p>21 May in your original report; is that right?</p> <p>22 A It is slightly different.</p> <p>23 Q Okay. Back in May of 2008 you were predicting</p> <p>24 that after 30 years, the phosphorus loads would</p> <p>25 decline before stabilizing, were you not? 10:57AM</p>
Page 71	Page 73
<p>1 cover page, every one of those 49 pages is devoted</p> <p>2 to correcting a mistake or mistakes that were</p> <p>3 present in your May 22nd report; is that right?</p> <p>4 A These all flowed from the one mistake.</p> <p>5 Q But every page corrects a mistake or an 10:54AM</p> <p>6 inaccuracy; is that right?</p> <p>7 A Well, pages 1 and 2 describe what happened,</p> <p>8 why -- describe the mistake.</p> <p>9 Q Okay. Fair enough. So Pages 4 through 48,</p> <p>10 which would be 44 pages, are devoted to actually 10:54AM</p> <p>11 correcting inaccurate information that was present</p> <p>12 in your prior report; is that right?</p> <p>13 A Yes. This is providing that correction.</p> <p>14 Q Do you have both of your reports in front of</p> <p>15 you, your original report and your errata report? 10:55AM</p> <p>16 A Yes, I've got the original that's marked</p> <p>17 Exhibit 2. Is that --</p> <p>18 Q Yes, the original is marked Exhibit 2. In</p> <p>19 your original -- I'm sorry. Let's go to your</p> <p>20 September report. On Page 3 you have a summary of 10:55AM</p> <p>21 your conclusions.</p> <p>22 A Okay.</p> <p>23 Q Now, Dr. Engel, in Opinion No. 2 of your</p> <p>24 September report, you predict, based upon your</p> <p>25 model, that if poultry litter continues to be 10:56AM</p>	<p>1 A They would decline very slightly and would</p> <p>2 fluctuate around some value. So they would -- they</p> <p>3 were predicted to decline slightly.</p> <p>4 Q Okay, but now you're of the opinion that that</p> <p>5 prediction is inaccurate; right? 10:58AM</p> <p>6 A Well, the prediction changed very little. So</p> <p>7 if you look at the data, the prediction changed very</p> <p>8 little. So phosphorus loads increased during the</p> <p>9 first 30 years in both cases and then they began to</p> <p>10 fluctuate a bit, and in the original report, the 10:58AM</p> <p>11 model that had the minor mistake, the values</p> <p>12 declined a little bit for a few years.</p> <p>13 Q Okay, but just so I'm clear, you're no longer</p> <p>14 of the opinion, are you, Dr. Engel, that the</p> <p>15 phosphorus loads in Lake Tenkiller, if poultry 10:58AM</p> <p>16 litter continues to be applied, will decline after</p> <p>17 30 years before stabilizing?</p> <p>18 A The model suggests that they will stabilize.</p> <p>19 MR. GARREN: Object to the form. Did you</p> <p>20 say 30 years? 10:59AM</p> <p>21 MR. GEORGE: I said after 30 years.</p> <p>22 MR. GARREN: Thank you.</p> <p>23 A So the model suggested that after 30 years, as</p> <p>24 this was corrected, that phosphorus levels to Lake</p> <p>25 Tenkiller would stabilize beyond that. 10:59AM</p>

19 (Pages 70 to 73)

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<p>1 Q But you no longer believe that that prediction 2 is accurate; is that right? 3 MR. GARREN: Object to form. 4 A Which prediction? You've got me confused. 5 Sorry. 10:59AM 6 Q The one that you made in May of 2008 based 7 upon your GLEAMS model where you said on Page 2 that 8 the phosphorus loads to Lake Tenkiller would decline 9 after the first 30 years of continued litter 10 application before stabilizing. 10:59AM 11 A So at this stage, I believe that they will 12 stabilize and that they don't decline. 13 Q Okay. 14 A And that's consistent with what one, in 15 reality, would expect. 10:59AM 16 Q Okay. So, Dr. Engel, as of today, what is 17 your opinion; is it the one you expressed in May of 18 2008 or the one that you expressed in September of 19 2008? 20 MR. GARREN: Objection to form. 11:00AM 21 A It would be the one in September of 2008. 22 Q Okay. Are you confident in that prediction? 23 A Yes. 24 Q Okay. 25 A Sorry. 11:00AM</p>	<p>1 A Well, the model suggests something. You know, 2 one would logically looking at trends that are in 3 observed data over the past -- well, since the '80s, 4 USGS has seen upward trends in phosphorus that tend 5 to match growth in the poultry industry. So if one 11:01AM 6 assumes that, you know, the industry continues to 7 operate with the same practices, those trends are 8 likely to hold. 9 Q All right. You said the model suggests. 10 That's kind of how you started your answer, Dr. 11:02AM 11 Engel, and I'm not interested in what the model 12 suggests because the model can't testify; you can; 13 right? 14 A Right. 15 Q So what does Dr. Engel believe, and it can be 11:02AM 16 based on a model, to a reasonable degree of 17 scientific certainty will happen in Lake Tenkiller 18 30, 70 or a hundred years from now if poultry litter 19 continues to be applied? 20 A Well, to answer that question, you're going to 11:02AM 21 have to make some assumption about land uses and 22 other practices within the IRW, about weather, about 23 other things. So is it okay if I make some 24 assumptions there? 25 Q Is it okay from a scientific perspective to 11:02AM</p>
Page 75	Page 77
<p>1 Q You think you got it right this time? 2 MR. GARREN: Object to form. 3 A Well, it's not significantly different than it 4 was in the original report. 5 Q I just want to know, Dr. Engel, when we get to 11:00AM 6 trial in this case, are you going to take the stand 7 and say that if poultry litter continues to be 8 applied, there will be an increase in phosphorus 9 loads for the first 30 years and then they will 10 stabilize over the next 70 years. Is that your 11:00AM 11 opinion? 12 MR. GARREN: Object to the form. 13 A That's my opinion as of today. 14 Q Well, do you plan on changing that opinion? 15 A I suppose if there were new data that came 11:00AM 16 forward, you know, that could change. 17 Q If you ran your model again, it could change? 18 MR. GARREN: Object to the form. 19 Q Is that right? 20 A I didn't say that. 11:01AM 21 Q Do you really know, Dr. Engel, what the 22 phosphorus concentration in Lake Tenkiller is going 23 to do 30 or 70 or a hundred years from now if 24 poultry litter continues to be applied? 25 MR. GARREN: Object to form. 11:01AM</p>	<p>1 make assumptions? 2 A Certainly. 3 Q Okay. Do you agree those assumptions need to 4 be well founded in reality? 5 A Yes. 11:03AM 6 Q Okay. So go ahead. 7 A So, you know, based on the modeled results, 8 based on trends in data, long-term trends in 9 observed phosphorus loads to the lake, you know, I 10 would anticipate that one would continue to see 11:03AM 11 loads increasing or at least of a comparable 12 magnitude as to what we have now, assuming that 13 conditions in the watershed don't change, assuming 14 that, you know, there's not a drastic shift in 15 weather, drastic change in land use and other things 11:03AM 16 that would go into that. 17 Q Dr. Engel, is it reasonable to assume that 18 land use will not change in the watershed in the 19 next hundred years? 20 MR. GARREN: Object to form. 11:03AM 21 A Land use will likely change. 22 Q Okay, but your opinion is based upon the 23 assumption that it will not, is it not? 24 A Correct. 25 Q Let's go back to your errata report, which is 11:04AM</p>

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<p>1 September. Do you have it? I want to look at  2 Opinion No. 3 on Page 3, and, Dr. Engel, in Opinion  3 No. 3 in September of 2008 you predict, based upon  4 your model, that if poultry litter applications are  5 halted in the watershed, phosphorus loads would be 11:04AM  6 reduced by 18 percent in the next ten years; is that  7 correct?  8 A Correct.  9 Q Okay. Do you stand by that prediction or  10 opinion today? 11:04AM  11 A Yes.  12 Q Okay. Now, that's not the opinion you offered  13 back in May of 2008 based upon a different model  14 run, is it?  15 A So the May opinion had a different reduction 11:05AM  16 level of 16 percent. So this suggests slightly more  17 reduction in phosphorus loads following cessation.  18 Q So back in May of 2008, you were predicting  19 the phosphorus loads would be reduced by only 16  20 percent in the next ten years; is that right? 11:05AM  21 A Correct.  22 Q You no longer stand by that opinion?  23 A My opinion today is that they would be reduced  24 by 18 percent.  25 Q Will they really be reduced by 18 percent if 11:05AM</p>	<p>1 (Following a short recess at 11:07  2 a.m., proceedings continued on the Record at 11:18  3 a.m.)  4 VIDEOGRAPHER: We are back on the Record.  5 The time is 11:18 a.m. 11:18AM  6 Q Dr. Engel, do you have your September report  7 in front of you still?  8 A I do.  9 Q Okay, and would you look at Opinion 4 on Page  10 3 with me for a moment. 11:19AM  11 A Okay.  12 Q Dr. Engel, in your September report you  13 predict if the poultry industry continues to grow  14 over the next 50 years at the same rate that it has  15 grown over the last 20 years, that the phosphorus 11:19AM  16 loads to Lake Tenkiller will increase by 70 percent;  17 is that correct?  18 MR. GARREN: Object to form.  19 A Yes.  20 Q Okay. Do you stand by that prediction or 11:19AM  21 opinion today?  22 A Yes.  23 Q Okay. Now, that's not the opinion or  24 prediction that you offered back in May of 2008  25 based upon a different model run, is it? 11:19AM</p>
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<p>1 poultry litter is halted within the next ten years?  2 A There's certainly -- there are multiple lines  3 that would suggest that that would be the case.  4 Q Well, what is your opinion? Will they really?  5 A Well, it certainly depends on other factors, 11:06AM  6 but assuming that the only thing we change is a  7 change in poultry waste land applications, we turn  8 that off, if we get the same weather that we've seen  9 in the past -- from '97 to 2006, the expectation is  10 that phosphorus loads would be decreased by 18 11:06AM  11 percent.  12 Q You're also assuming in that prediction, are  13 you not, that there will be no changes in land use  14 in the watershed in the next ten years?  15 A That's correct, so as I stated, if we hold 11:06AM  16 everything else constant.  17 Q You realize the world doesn't stay constant;  18 right?  19 A That's correct.  20 Q Let's look at your September errata report, 11:06AM  21 Opinion No. 4.  22 MR. GEORGE: Let's go ahead and change out  23 the tape.  24 VIDEOGRAPHER: We're now off the Record.  25 The time is 11:07 a.m. 11:07AM</p>	<p>1 A So it looks like in May the predicted increase  2 was greater. It was predicted at 92 percent rather  3 than 70 percent. So this -- this is one that went a  4 different direction.  5 Q Changed significantly; would you agree? 11:19AM  6 MR. GARREN: Object to the form.  7 A Well, you know, a 70 percent increase in  8 phosphorus attributable to land application of  9 poultry waste versus 92 percent, both of those are  10 quite large. 11:20AM  11 Q But is there a significant difference to you  12 between 92 percent of a load allocation and 70  13 percent?  14 MR. GARREN: Object to form.  15 A I think it depends on the context. 11:20AM  16 Q Well, in the context of this lawsuit, is that  17 significant to you, Dr. Engel?  18 A These are both quite large.  19 Q Do you want to answer my question? Is it  20 significant to you? 11:20AM  21 A What is -- are you asking is 92 versus 70  22 significant?  23 Q I'm asking whether the difference between your  24 prediction in May of 2008 of 92 percent and your  25 prediction in September of 70 percent is significant 11:21AM</p>

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<p>1 to you in the context of this litigation?</p> <p>2 A I would indicate again that both are quite</p> <p>3 large, and so my opinion that, you know, continued</p> <p>4 or increased waste application is going to</p> <p>5 exacerbate the problem, yeah. At 70 it does that; 11:21AM</p> <p>6 at 92 percent it does that.</p> <p>7 Q Okay. There's no real difference to you</p> <p>8 between those two numbers, the 70 and the 92</p> <p>9 percent?</p> <p>10 A The numbers are different. The conclusions 11:21AM</p> <p>11 one reaches from that is not.</p> <p>12 Q Okay. So you can -- your numbers can be off</p> <p>13 by as much as 22 percent and you still reach the</p> <p>14 same conclusion; is that right?</p> <p>15 MR. GARREN: Object to form. 11:21AM</p> <p>16 Q Is that what I heard you say?</p> <p>17 MR. GARREN: Object to form.</p> <p>18 A You're misinterpreting what I'm saying.</p> <p>19 Q Now, in making the prediction that you stand</p> <p>20 by today of a 70 percent allocation to poultry 11:21AM</p> <p>21 years from now, assuming the growth rate that you</p> <p>22 assumed, Dr. Engel, did you also assume there would</p> <p>23 be no other changes in the watershed in the next 50</p> <p>24 years?</p> <p>25 A Yes. So the assumption was that there were no 11:22AM</p>	<p>1 else the same, what happens if, and the if here was</p> <p>2 what happens if we see continued increase in poultry</p> <p>3 production and continued increase in land</p> <p>4 application of waste.</p> <p>5 Q Who told you that was the targeted question 11:24AM</p> <p>6 that you were to answer?</p> <p>7 A That was the question I was asked to answer.</p> <p>8 Q Asked by who?</p> <p>9 A Asked by the State of Oklahoma's team.</p> <p>10 Q Through who? 11:24AM</p> <p>11 A Probably would have been through David Page.</p> <p>12 Q Do you still have your September report with</p> <p>13 you? Can you look at Opinion 7? It's also on Page</p> <p>14 3. In September of this year, your opinion, Dr.</p> <p>15 Engel, was that phosphorus loads to Tenkiller have 11:24AM</p> <p>16 increased at a rate of 8,000 pounds per year since</p> <p>17 1954 and that poultry litter applications are</p> <p>18 responsible for 4,700 pounds or 59 percent of this</p> <p>19 increase each year. Do you see that?</p> <p>20 A That's not exactly how it was read or how it 11:24AM</p> <p>21 was written. I'm sorry.</p> <p>22 Q Okay. Read it to me, please. I apologize.</p> <p>23 A So P loads to Lake Tenkiller since 1954 have</p> <p>24 increased at approximately 8,000 pounds per year.</p> <p>25 Poultry waste application in the IRW is responsible 11:25AM</p>
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<p>1 other changes, and, you know, that's the purpose of</p> <p>2 modeling. So the idea here was to control all other</p> <p>3 variables and see what happens when we change the</p> <p>4 one input, poultry waste land application.</p> <p>5 Q In the real world, though, more than one 11:22AM</p> <p>6 variable changes in a 50-year time span in a</p> <p>7 watershed, would you agree?</p> <p>8 A It would but, again, the purpose of a modeling</p> <p>9 -- this is the way people would tend to use models</p> <p>10 -- is, you know, it allows one to control for those 11:22AM</p> <p>11 other changes if one desires. The goal here wasn't</p> <p>12 to change other things and see what happens. The</p> <p>13 goal was to understand if we see increased poultry</p> <p>14 production and increased land application of waste,</p> <p>15 what happens. If one wanted to go back and make 11:23AM</p> <p>16 more model runs to change, you know, these other</p> <p>17 assumptions maybe you want to change, yeah, the</p> <p>18 model would let you do that.</p> <p>19 Q Dr. Engel, why was it not your goal in</p> <p>20 developing predictions based upon the model to 11:23AM</p> <p>21 describe what is actually likely to occur in the</p> <p>22 watershed?</p> <p>23 A Again, you know, typically with models, you</p> <p>24 know, they allow you to ask targeted questions, and</p> <p>25 the targeted question here was, leaving everything 11:23AM</p>	<p>1 for approximately 4,700 pounds of this increase each</p> <p>2 year.</p> <p>3 Q Okay. What is the percentage of 4,700</p> <p>4 compared to the 8,000 increase per year; do you</p> <p>5 know? 11:25AM</p> <p>6 A I can calculate it.</p> <p>7 Q Do it, if you don't mind. I don't think it</p> <p>8 will take you long.</p> <p>9 A So to the nearest percentage, 59 percent.</p> <p>10 Q Okay. So do I understand correctly, Dr. 11:25AM</p> <p>11 Engel, that the opinion in your September report is</p> <p>12 that poultry litter applications are responsible for</p> <p>13 59 percent of the increase each year in the</p> <p>14 phosphorus load to Lake Tenkiller since 1954?</p> <p>15 A Well, realize that this is a regression line 11:26AM</p> <p>16 through that. So indicating that that is happening</p> <p>17 each year is an overreach on this I think. So on</p> <p>18 average each year, it's increasing this amount.</p> <p>19 Q 59 percent?</p> <p>20 A 59 percent. 11:26AM</p> <p>21 Q Okay. Now --</p> <p>22 A No, I'm sorry. So the increase is not 59</p> <p>23 percent. The increase was 8,000 pounds a year</p> <p>24 overall. 4,700 pounds a year attributable to</p> <p>25 poultry waste application, so -- 11:26AM</p>

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1 Q And that poultry litter application share of  
 2 the increase is 59 percent; correct?  
 3 A The share of the increase would be 59 percent.  
 4 Q Okay. Thank you. Now, do you stand by those  
 5 opinions today, Dr. Engel? 11:27AM  
 6 A Yes.  
 7 Q Those are not the opinions you offered back in  
 8 May based upon a different model run, are they?  
 9 A So, again --  
 10 Q Can I get a yes or no first? 11:27AM  
 11 A Yes.  
 12 Q Those are the same opinions you offered back  
 13 in May?  
 14 A Yes, you can get an opinion.  
 15 Q Okay. 11:27AM  
 16 A Sorry. I was trying to --  
 17 Q Let's try it again. I do -- I'll give you a  
 18 chance to explain. I want a clear Record first.  
 19 Dr. Engel, the opinions that we just established  
 20 from your September report regarding the percent 11:27AM  
 21 increase each year associated with poultry litter  
 22 are different than the opinions you offered in 2008  
 23 based upon a different model run; is that right?  
 24 A So the opinion is different, yes, and, in  
 25 fact, based on the revision in September, the 11:27AM

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1 contribution percentage-wise, if you want to think  
 2 of it that way, attributable to poultry decreases  
 3 from 66 percent to the 59 percent we just computed.  
 4 Q Okay. So between your May report and your  
 5 September report, the average annual percentage of 11:28AM  
 6 the poultry contribution to the load to Lake  
 7 Tenkiller has declined; is that right?  
 8 MR. GARREN: Object to the form.  
 9 A I'm not sure I'm answering the right question  
 10 here. So the average annual -- so, yes, the average 11:28AM  
 11 annual poultry contribution percentage has gone from  
 12 66 to 59 percent, so it's declined.  
 13 Q Okay. Why did you not change then, Dr. Engel,  
 14 in your September 2008 errata report the opinion 11:28AM  
 15 that you had offered in your prior report as Opinion  
 16 8 on Page 2, that poultry litter is a substantial  
 17 contributor between 45 percent from the time period  
 18 of '98 to 2006 or 59 percent between 2003 and 2006?  
 19 A So Opinion 8 in the May report is based on a  
 20 set of data that was correct in the May report. 11:29AM  
 21 Q Well, I thought you told me earlier that  
 22 Opinion 8 was based upon the output of your model.  
 23 A Opinion 8 was based on the output of the  
 24 model.  
 25 Q Okay, and you wrote the September report based 11:29AM

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1 upon the wrong output of the model; is that right?  
 2 A Realize that the -- could you repeat that  
 3 question again, sir? I'm sorry.  
 4 Q You wrote your May report that contains this  
 5 Opinion No. 8 based upon an incorrect run or the 11:30AM  
 6 inappropriate output from the model; is that right?  
 7 A Some of the -- just a portion of the report is  
 8 based on an incorrect output of the model.  
 9 Q Okay. Let me ask it as basic as I can. How  
 10 is it, Dr. Engel, that your opinion about the annual 11:30AM  
 11 contribution of poultry litter to the increased P  
 12 load each year has changed but your opinion about  
 13 the relative contribution of poultry litter to the  
 14 phosphorus loads for the aggregated periods has not  
 15 changed? 11:30AM  
 16 A Those are different model runs and different  
 17 model outputs.  
 18 Q Well, do you have an opinion today as to what  
 19 is the relative contribution of poultry litter  
 20 between '98 and 2006? 11:30AM  
 21 A It was the same as what was reported in the  
 22 May report.  
 23 Q 45 percent?  
 24 A Well, let's look at it. Yeah, at Opinion 8.  
 25 Opinion 8 indicates between 1998 and 2006 poultry 11:31AM

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1 contribution was 45 percent.  
 2 Q Okay, and that remains the same today; you  
 3 have the same opinion despite the fact that you've  
 4 now concluded that you had previously overstated the  
 5 annual contribution of poultry to the increasing 11:31AM  
 6 phosphorus loads?  
 7 MR. GARREN: Object to the form.  
 8 A Opinion 8 is the same as it was.  
 9 Q Help me reconcile those two. Do you see my  
 10 difficulty in understanding? 11:31AM  
 11 A Sure.  
 12 MR. GARREN: Object to form.  
 13 Q Help me reconcile.  
 14 A So the model runs associated with Opinion 7  
 15 that we had just talked about is a different set of 11:32AM  
 16 model runs than that associated with Opinion 8.  
 17 Q What were the model runs associated with  
 18 Opinion 8?  
 19 A So Opinion 8 used a set of model runs that,  
 20 unbeknownst to me at the time, had been corrected. 11:32AM  
 21 Q Okay, but now they've been corrected, you  
 22 haven't changed your Opinion 8; is that right?  
 23 A So, again, when the May report was written,  
 24 Opinion 8 used a corrected set of results. I didn't  
 25 know at that point that we had an error in other 11:32AM

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<p>1 model outputs, and so Opinion 8 was based on a set 2 of model outputs that had had this problem that 3 we've talked about in the prior couple of hours 4 corrected.</p> <p>5 Q Okay, okay. So, Dr. Engel, maybe I now 11:32AM 6 understand. When you wrote your opinion, your 7 report in May of 2008, you wrote it based upon 8 both -- in some instances, the correct model run and 9 in other instances the incorrect model run; is that 10 right? 11:33AM</p> <p>11 A That's right.</p> <p>12 Q All right, and it's your testimony, Dr. Engel, 13 that Opinion No. 8 in your original report was 14 written based upon the modeling runs that did not 15 have the code error that was subsequently 11:33AM 16 identified; is that right?</p> <p>17 A That's right.</p> <p>18 Q Okay. Why would you use two different model 19 runs in preparing the same report?</p> <p>20 A Well, actually there are numerous model runs 11:33AM 21 that were used in preparing the report.</p> <p>22 Q Right, but with respect to the phosphorus 23 simulation and the scenarios that you were running 24 and the opinions that you were expressing, based 25 upon those runs, why would you use two different 11:34AM</p>	<p>1 Q Okay. If it's in this report, unless it's 2 changed by a subsequent document that we've already 3 received, it's a reflection of your opinion today?</p> <p>4 A Correct.</p> <p>5 Q Okay. Did anyone other than you participate 11:35AM 6 in the preparation of either your May or your 7 September reports?</p> <p>8 A Let's look here a moment so I get the right 9 pieces attributed to the right people. So Appendix 10 B, Appendix B, the Illinois River watershed 11:36AM 11 phosphorus mass balance study, was authored by 12 Meagan Smith under my supervision.</p> <p>13 Q Let me stop you there for a second. We'll 14 take them one by one. Does Meagan Smith work for 15 you at Purdue University? 11:36AM</p> <p>16 A No, she does not.</p> <p>17 Q Where is Meagan Smith located?</p> <p>18 A I believe she is here in the Tulsa area.</p> <p>19 Q Okay. Did you hire Meagan Smith?</p> <p>20 A No. 11:36AM</p> <p>21 Q Okay. Did you pay for her work in this case?</p> <p>22 A No, I did not.</p> <p>23 Q How many hours did you spend with Meagan Smith 24 working on the mass balance study that she authored 25 as Appendix B to your report? 11:36AM</p>
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<p>1 sets of those runs to offer opinions about the same 2 general topic?</p> <p>3 MR. GARREN: Object to form.</p> <p>4 A So, again, there were multiple phosphorus 5 runs, most of which were different, that went into 11:34AM 6 the varying opinions here.</p> <p>7 Q Let's talk about the relationship between your 8 May 2nd -- I'm sorry, your May 22nd report and your 9 September 4th report, Dr. Engel. Can we assume that 10 all of the opinions, charts, figures and statements 11:34AM 11 in your 200-page original report still reflect your 12 opinion as of today unless they were expressly 13 changed by Exhibit No. 4, your September 4th report?</p> <p>14 A I guess there was also the October things that 15 were also modified. 11:35AM</p> <p>16 Q Okay. You're talking about the corrections to 17 the tables that we identified in Exhibit No. 4?</p> <p>18 A Well, there were, what, two tables, some 19 figures.</p> <p>20 Q Well, let me ask it this way: Is your 11:35AM 21 original report still good and a reflection of your 22 opinions unless expressly modified by the September 23 4th report or the October amendment that you are 24 referring to?</p> <p>25 A Yes. 11:35AM</p>	<p>1 A Well, giving you a specific number would be 2 tough.</p> <p>3 Q Ballpark it.</p> <p>4 A A ballpark is okay. 150 to 200.</p> <p>5 Q What specific changes in the report that she 11:37AM 6 authored did you propose?</p> <p>7 MR. GARREN: Object as to form.</p> <p>8 A Boy, specifics is going to be tough. As I 9 recall, this is probably in some of the E-mails and 10 things produced. As I recall, there was a marked up 11:37AM 11 copy, you know, that had some suggested edits and 12 notes in it, you know. Throughout the -- well, 13 throughout the analysis and throughout the 14 preparation, there would have been, you know, 15 ongoing dialogues and discussions. 11:37AM</p> <p>16 Q Who actually performed the computations that 17 are set forth in Appendix B, the mass balance study?</p> <p>18 A So Meagan would have performed those.</p> <p>19 Q Okay, and who would have actually reviewed the 20 data on which those computations are based? 11:38AM</p> <p>21 A Well, Meagan certainly reviewed the data. You 22 know, I reviewed spreadsheets that contain 23 summarized data. I reviewed some of the underlying 24 data in some circumstances as well.</p> <p>25 Q Did you count on her to review all of the 11:38AM</p>

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<p>1 true?</p> <p>2 A Yeah, I would disagree with this</p> <p>3 characterization as a blanket statement.</p> <p>4 Q Do you also disagree with the statement of</p> <p>5 limitation on the GLEAMS model contained in this 03:12PM</p> <p>6 appendix that says it is not suited for urban land</p> <p>7 uses?</p> <p>8 A Well, again, it depends on the questions being</p> <p>9 asked. So if this is being used to try to model</p> <p>10 transport of heavy metals from urban areas, GLEAMS 03:12PM</p> <p>11 is not the model to do that. So, again, you have to</p> <p>12 have the right context in interpreting these</p> <p>13 statements. So if one is looking at runoff, looking</p> <p>14 at transport of nutrients, you know, the</p> <p>15 capabilities are fine for use in urban areas. 03:12PM</p> <p>16 Q What is it about GLEAMS that you believe makes</p> <p>17 it suitable to evaluate runoff of nutrients from</p> <p>18 urban areas but not runoff of metals from nutrient</p> <p>19 (sic) areas?</p> <p>20 A Well, they're not routines -- using metals as 03:13PM</p> <p>21 the specific example here again, there are not</p> <p>22 routines in GLEAMS that are accounting for metal</p> <p>23 buildup and movement in urban areas in GLEAMS.</p> <p>24 Q And isn't that the case because GLEAMS is not</p> <p>25 a model that deals with metals at all? 03:13PM</p>	<p>1 further with those other than report that, you know,</p> <p>2 that that water and the constituents being carried</p> <p>3 with it have reached the edge of the world according</p> <p>4 to the model.</p> <p>5 Q Dr. Engel, what did you do to calibrate the 03:15PM</p> <p>6 GLEAMS model to edge of field data?</p> <p>7 A So in this instance, we didn't do specific</p> <p>8 calibration to the edge of the field because it</p> <p>9 wasn't necessary. We did that indirectly, and the</p> <p>10 process, you know, was to calibrate this such that 03:16PM</p> <p>11 the nutrients that arrived at Tahlequah, Baron Fork</p> <p>12 near Eldon and at Caney Creek gauges so that that</p> <p>13 phosphorus was correct over the ten-year period or I</p> <p>14 guess five-year period for calibration and looked</p> <p>15 beyond that for a validation. I'm not sure I said 03:16PM</p> <p>16 that right. Five years initially for calibration</p> <p>17 and then five years for validation so that the</p> <p>18 phosphorus over that period matched the observed</p> <p>19 phosphorus when combined with the wastewater</p> <p>20 treatment plant phosphorus that was reaching those 03:16PM</p> <p>21 gauging stations. So it turns out that, you know,</p> <p>22 because phosphorus is a conservative substance, you</p> <p>23 know, that's a perfectly acceptable technique that</p> <p>24 one could employ to calibrate the model and,</p> <p>25 therefore, it wasn't necessary to match this to 03:17PM</p>
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<p>1 A That's correct.</p> <p>2 Q So GLEAMS would not be an appropriate model in</p> <p>3 an agricultural setting either, would it?</p> <p>4 A No, it would not. So my interpretation of</p> <p>5 this statement, and I think if you would check with 03:13PM</p> <p>6 the author and if you consult the scientific</p> <p>7 literature, you know, GLEAMS is routinely used in</p> <p>8 watersheds that have urban areas. In fact, again,</p> <p>9 back to this paper from northeast Indiana, some of</p> <p>10 the land use there was urban. 03:14PM</p> <p>11 Q Let's go back a page, I'm sorry, to Page 210</p> <p>12 of this appendix. Do you see that the model feature</p> <p>13 for GLEAMS is described as an edge of field</p> <p>14 simulation model?</p> <p>15 A Which line? I'm sorry. 03:14PM</p> <p>16 Q I'm sorry. Page 210 under model features.</p> <p>17 A Okay, yes.</p> <p>18 Q What do you understand that to mean, that</p> <p>19 GLEAMS is an edge of field simulation model?</p> <p>20 A So what that means is that, you know, GLEAMS 03:14PM</p> <p>21 is going to perform computations that calculate</p> <p>22 runoff movement of constituents, whether they be</p> <p>23 nutrients, pesticides, sediment to the edge of the</p> <p>24 field, and then at that point from its point of</p> <p>25 view, the world ends. So it doesn't do anything 03:15PM</p>	<p>1 every single edge of field; it wasn't a necessary</p> <p>2 step.</p> <p>3 Q Did you match it to any single edge of field</p> <p>4 sample?</p> <p>5 A I didn't. Others have. It wasn't necessary 03:17PM</p> <p>6 in this case.</p> <p>7 Q Dr. Engel, how can you confirm that the GLEAMS</p> <p>8 model, as you used it in this case, accurately</p> <p>9 predicted the amount of phosphorus leaving fields</p> <p>10 that had received poultry litter if you did not 03:17PM</p> <p>11 compare the results of the GLEAMS model to any edge</p> <p>12 of field environmental sampling data?</p> <p>13 MR. GARREN: Object to form.</p> <p>14 A Could you repeat that again?</p> <p>15 Q Probably not but we can have it read back. 03:18PM</p> <p>16 (Whereupon, the court reporter read</p> <p>17 back the previous question.)</p> <p>18 A Okay. So, again, through the calibration</p> <p>19 process at the scale of the gauging stations at</p> <p>20 Tahlequah, Baron Fork at Eldon or near Eldon and 03:18PM</p> <p>21 Caney Creek, through that calibration, because of</p> <p>22 the representation of the unique combinations of</p> <p>23 soils and land uses and management and weather</p> <p>24 within each of those watersheds, when one calibrates</p> <p>25 the parameters assigned to those hydrologic response 03:19PM</p>

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1 Q So it's not a model?		1 speeches that don't answer the question, I'm going	
2 A Well, certainly one could call an equation a		2 to start deducting those from my allotted time. I	
3 model, so --		3 don't want it held against me.	
4 Q So does it have a name?		4 Linda, could you -- I'm sorry. Lisa, could	
5 A You know, throughout the report it's typically	03:43PM	5 you read back the question and, Dr. Engel, could you	
6 referred to as the routing equation or routing		6 answer it this time?	
7 model.		7 (Whereupon, the court reporter read	
8 Q Have you used this particular routing model in		8 back the previous question.)	
9 any previous application, Dr. Engel?		9 A So the answer you are looking for would be no	
10 A Again, this is simply a regression equation.	03:43PM	10 but let me qualify it. So one would not expect to	03:47PM
11 So, again, it's an equation that used observed data		11 find this specific equation that was uniquely	
12 over a ten-year period, and coefficients for that		12 derived for this watershed from data. So it's	
13 equation were calculated to match. So it's a simple		13 unique to the data from this watershed. You can't	
14 regression equation.		14 get much better than a relationship between all this	
15 Q Let's -- so we have a clear Record of this,	03:44PM	15 observed data in this watershed.	03:47PM
16 can you read what the equation is that you are		16 Q Dr. Engel, have you independently tested your	
17 referring to as either your P routing model or your		17 phosphorus routing model or equation to determine if	
18 P routing equation?		18 it is a valid and realistic simulation of what	
19 A Okay. So I guess P load equals A plus B times		19 actually happens in the stream systems in the	
20 Q times P accumulation plus C times Q squared times	03:44PM	20 Illinois River watershed?	03:47PM
21 P accumulation.		21 A There's no reason to perform that test. It's	
22 Q Dr. Engel, have you used that equation in any		22 not -- it's not necessary for the project.	
23 prior modeling application?		23 Q Please take me through the detailed process	
24 A I've not used this specific equation but		24 using site-specific data that resulted in the	
25 certainly, you know, the use of regression equations	03:44PM	25 development of this equation that you are referring	03:48PM
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1 is a well-accepted approach for taking care of		1 to as your routing model in this case, Dr. Engel.	
2 relationships between things.		2 MR. GARREN: Object to form.	
3 Q Dr. Engel, can you point me to any		3 A So you're asking for a step-by-step process of	
4 peer-reviewed study in which the equation that you		4 how this equation was arrived at or --	
5 just read has been used to simulate the physical	03:45PM	5 Q That's correct.	03:48PM
6 processes that occur as phosphorus moves from the		6 A Okay.	
7 edge of field downstream to a reservoir?		7 Q First of all, you agree you don't really	
8 MR. GARREN: Object to form.		8 explain that in your report, do you, how this	
9 A So, again, this equation is simply based on		9 equation was developed?	
10 observed data. It's not modeling those physical	03:45PM	10 A That's a good question. I don't know if I did	03:48PM
11 processes. It's simply a relationship between		11 or not.	
12 phosphorus inputs into the streams or edge of field		12 Q I've read your report many times. If you	
13 and what ultimately reaches the three gauging		13 could point me to it, I'd love to see it.	
14 stations. So, you know, creating regression		14 MR. GARREN: So, Counsel, are you saying	
15 equations of this type is standard practice when	03:45PM	15 it's there and he needs to find it?	03:49PM
16 working with data. This isn't out of the ordinary;		16 MR. GEORGE: I'm saying I just can't find	
17 this is not unique. This is a standard data-driven		17 it, but he left the Record unclear in terms of	
18 technique. You know, it's based on real observed		18 whether it was there, so --	
19 data from the IRW. So it's not a theoretical		19 A Well, there's a little bit of description. I	
20 equation in which we have to fit a bunch of	03:46PM	20 would admit there's not a lot of description on the	03:49PM
21 coefficients and try to figure out how to make it		21 prior page on D-20. So in reviewing the observed	
22 work. It's based on years of observed phosphorus		22 data from '97 through 2006, and there may have been	
23 load data and flow data from the specific watershed.		23 even some observed data before that that I reviewed,	
24 Q Move to strike, non-responsive.		24 observed data being -- well, I definitely reviewed	
25 MR. GEORGE: Rick, if we keep having these	03:46PM	25 observed data prior to that involving flows and	03:50PM

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<p>1 distinction. So it's just treating all phosphorus</p> <p>2 the same.</p> <p>3 Q Okay. So your phosphorus routing equation</p> <p>4 really tells you nothing about the source of the</p> <p>5 phosphorus that reaches Lake Tenkiller; is that 04:15PM</p> <p>6 fair?</p> <p>7 A Correct. This equation is not identifying the</p> <p>8 sources.</p> <p>9 Q Now, if you look on the following page, D-21</p> <p>10 of your report, Dr. Engel, there are some values 04:15PM</p> <p>11 that are referred to as coefficients that are used</p> <p>12 in your phosphorus routing model listed in Table 7;</p> <p>13 do you see that?</p> <p>14 A Okay. I'm on Page D-22.</p> <p>15 Q I'm sorry, what did I say? 04:15PM</p> <p>16 A I think you said D-21.</p> <p>17 Q I apologize, D-22, and in particular, you have</p> <p>18 for each of the subwatersheds, Tahlequah, Baron Fork</p> <p>19 and Caney Creek, a coefficient for the value A, B</p> <p>20 and C; do you see that? 04:16PM</p> <p>21 A Yes.</p> <p>22 Q And A, B and C are three of the variables that</p> <p>23 appear in your equation, phosphorus routing</p> <p>24 equation; correct?</p> <p>25 A Correct. 04:16PM</p>	<p>1 A So looks like it was the shuffled complex</p> <p>2 evolution piece of code but unique to fitting these</p> <p>3 coefficients as opposed to the same technique that</p> <p>4 was employed in calibrating the GLEAMS model.</p> <p>5 Q Well, who wrote this code that you're talking 04:18PM</p> <p>6 about from which the variable or the coefficient for</p> <p>7 B was determined?</p> <p>8 A So the shuffled complex evolution code was</p> <p>9 written by Dr. Ji-Hong for this particular</p> <p>10 application. 04:18PM</p> <p>11 Q What did he base that code on?</p> <p>12 A Well, the code is a well established or the</p> <p>13 algorithm approach from shuffled complex evolution</p> <p>14 is a well-established technique. So relying upon</p> <p>15 equations that are described in the literature for 04:19PM</p> <p>16 that technique, he developed code to best fit A, B,</p> <p>17 C, such that that equation would create the proper</p> <p>18 relationship between observed phosphorus at</p> <p>19 Tahlequah and the wastewater treatment inputs and</p> <p>20 the GLEAMS inputs for that particular watershed. 04:19PM</p> <p>21 Q Did Dr. Ji-Hong create the code that was used</p> <p>22 to calculate all of the coefficients that were used</p> <p>23 in your phosphorus routing model or equation?</p> <p>24 A Well, he created the code to compute A, B and</p> <p>25 C. 04:20PM</p>
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<p>1 Q What are those coefficients that are listed</p> <p>2 there? For example, one of them, B for Tahlequah is</p> <p>3 4.88 times 10 to the minus 7; what does that mean?</p> <p>4 A Well, so that particular coefficient was</p> <p>5 identified along with the other coefficients here, 04:16PM</p> <p>6 so that the equation on Page D-21 would match the</p> <p>7 observed phosphorus loads at Tahlequah -- we're</p> <p>8 talking about the Tahlequah location -- with the</p> <p>9 wastewater treatment inputs into the Illinois River</p> <p>10 watershed that drains to Tahlequah and the GLEAMS 04:17PM</p> <p>11 edge of field phosphorus loads that were delivered</p> <p>12 to or that were delivered within the Illinois River</p> <p>13 watershed draining to Tahlequah.</p> <p>14 Q Well, Dr. Engel, how was this particular</p> <p>15 number that you use in your equation for the 04:17PM</p> <p>16 coefficient B, 4.88 times 10 to the minus 7,</p> <p>17 established?</p> <p>18 A So this was established to make the</p> <p>19 relationship match that I just described.</p> <p>20 Q I don't want to know what it does. I want to 04:17PM</p> <p>21 know how it was established.</p> <p>22 A So this was established using a piece of code</p> <p>23 to calculate these coefficients using the</p> <p>24 relationships that I described.</p> <p>25 Q What kind of code? 04:18PM</p>	<p>1 Q Okay.</p> <p>2 A I created the form of the equation that we</p> <p>3 talked about back on Page D-21.</p> <p>4 Q I'm not interested in the equation right now.</p> <p>5 I want to know about the code that was used to 04:20PM</p> <p>6 create the coefficients in Table 7. Did Dr. Ji-Hong</p> <p>7 create all that code?</p> <p>8 A So if we're talking about the code to</p> <p>9 calculate the coefficients from the observed data,</p> <p>10 yes, Dr. Ji-Hong wrote that code. 04:20PM</p> <p>11 Q Okay. Now, this particular numerical value</p> <p>12 for B, which is at Tahlequah, which is 4.88 times 10</p> <p>13 to the minus 7, does that number have any physical</p> <p>14 meaning in the environmental system of the Illinois</p> <p>15 River watershed? 04:20PM</p> <p>16 A Let's see. There would probably be some</p> <p>17 physical meaning that one would interpret from it.</p> <p>18 I'm going to have to think about that. I hadn't</p> <p>19 thought about that question. So, you know, what</p> <p>20 it's doing, it's indicating that that coefficient 04:21PM</p> <p>21 times flow at Tahlequah times phosphorus that's been</p> <p>22 put into the Illinois River from GLEAMS and from the</p> <p>23 wastewater treatment plant, it's indicating that</p> <p>24 essentially this portion or at least this</p> <p>25 coefficient times these other two things identifies 04:21PM</p>

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<p>1 made further adjustments of these parameters and 2 this would be -- this would be typically done in 3 calibration. This is not unusual.</p> <p>4 Q What was the basis for your adjustments in 5 terms of how far and in what direction; how did you 6 decide that? 04:49PM</p> <p>7 A Well, the basis for the adjustments was to -- 8 I guess I was looking at the statistics reported on 9 the graphs on pages -- well, a graph that would be 10 Figure 15, so that's a calibration one, 16 and 17, 11 and trying to -- trying to pick up some of those 12 larger flow events that had had large amounts of 13 phosphorus observed at the respective gauging 14 stations.</p> <p>15 Q So how does Figure 15 tell you whether to turn 16 the initial P accumulation knob for Tahlequah four 17 degrees to the right or 7 degrees to the left? 04:49PM</p> <p>18 A Well, not unlike common approaches in 19 calibration, that's trial and error largely. It's 20 well accepted in scientific literature that in the 21 calibration process is in fact the majority of those 22 would be done manually. It would not be automated, 23 so you would have someone making a decision about 24 every one of these things to modify, and they would 25 modify them until they, you know, were comfortable 04:50PM</p> <p>04:51PM</p>	<p>1 unfortunately if you don't change the labeling, it 2 labels it series one, and then the line that it 3 draws through there is the linear fit for that 4 relationship and, again, it's linear series one is 5 the default. So this suggests that I did these in 6 the spreadsheet and never cleaned up the labels. 04:53PM</p> <p>7 Q And the other thing that seems consistent with 8 all of the figures that you produced in both of your 9 reports, Dr. Engel, is the absence of any 10 description of what the X and Y axes reflect and 11 their units. Do you see that? 04:53PM</p> <p>12 A Is it just the things in D here?</p> <p>13 Q I see the same thing in Appendix D to your May 14 22nd, 2008 report.</p> <p>15 A It looks like most of the figures prior to 16 this were better labeled. So one of these is going 17 to be predicted and one of these is going to be 18 observed, and it should be predicted on the Y, 19 observed on the X axis here. 04:53PM</p> <p>20 Q Dr. Engel, prior to you telling me that, how 21 was I or the experts working for the defendants 22 supposed to know that? 04:54PM</p> <p>23 A It looks like this was an oversight on my part 24 in getting those labeled.</p> <p>25 Q What are the units for the X and Y axes on all 04:54PM</p>
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<p>1 with the performance.</p> <p>2 Q What do you mean comfortable with the 3 performance?</p> <p>4 A Well, they would typically be looking at data 5 like we see in Figure 15, 16 or 17. They would be 6 looking at the relationship between the observed 7 value, the predicted value. You would be looking at 8 R-squareds. You might look at some other things 9 potentially as well, and based on your professional 10 judgment, would be deciding when those relationships 11 were suitable to move on to the next step. It's a 12 well-accepted process, well-accepted technique that, 13 you know, most modelers in watershed modeling 14 employ. 04:51PM</p> <p>15 Q While we're looking at Figure 15 in your 16 September 4, 2008 errata, and I think this 17 observation is true of all the figures that you 18 produced in both of your reports, why are all of 19 these graphs labeled series one and linear series 20 one? 04:51PM</p> <p>21 A Probably means I was lazy.</p> <p>22 Q What does that mean, series one and linear 23 series one?</p> <p>24 A Vic knows I was lazy. So I think what that 25 means is that within Excel, the default, 04:52PM</p>	<p>1 of the figures that you included in your Appendix D 2 to both of your reports?</p> <p>3 A Well, they're phosphorus loads and they're 4 daily phosphorus loads and the units. Is that the 5 remaining part of the question? 04:55PM</p> <p>6 Q Yeah. I am interested in the units.</p> <p>7 A I believe those are going to be in kilograms, 8 but to be absolutely certain, I would need to look 9 at the spreadsheet in which these were produced.</p> <p>10 Q As we sit here today, you're not sure what the 11 units are? 04:55PM</p> <p>12 A Well, they're kilograms or pounds.</p> <p>13 Q There's a difference, isn't there?</p> <p>14 A About 2.2 would be the factor of difference, 15 yeah. I believe they're kilograms, but I would need 16 to look to -- so I didn't mislead you. 04:56PM</p> <p>17 Q All right. Dr. Engel, let's move to another 18 exhibit. I'm going to hand you what I've marked as 19 Exhibit 11 to your deposition, which is an October 20 2007 which you are listed as the principal author, 21 along with Dan Storm, entitled A Hydrologic Water 22 Quality Model Application Protocol, published in the 23 Journal of American Water Resources Association. Do 24 you recognize this article, Dr. Engel? 04:57PM</p> <p>25 A Yes. 04:57PM</p>

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1 exercise to make the assumption that water runs  
2 uphill?  
3 A Well, one could have done that. It probably  
4 wouldn't have been a very good assumption, and I  
5 would agree with you on that but -- 05:04PM

6 Q All right. I'm not -- let me approach it this  
7 way: Do you agree that your modeling work in this  
8 case assumes that all of the litter, poultry litter  
9 that is generated in the Illinois River watershed,  
10 other than -- I think it's 900,000 tons that are 05:05PM  
11 exported by BMPs a year --

12 MR. GARREN: Object to form then.

13 MR. GEORGE: Hang on.

14 Q And some amount exported by George's is  
15 applied in the Illinois River watershed? 05:05PM

16 MR. GARREN: Object to form again.

17 A So I guess let me back up just a moment. So  
18 I've done some calculations of waste that's been  
19 generated in the IRW, and I've seen some of the data  
20 that talked about how much has been exported, and I 05:05PM  
21 believe in your question you indicated there was  
22 900,000 years -- 900,000 tons a year being exported?

23 MR. McDANIEL: What?

24 Q Oh, 90,000. I'm sorry. Zero, 70 percent, 90  
25 percent, it doesn't matter, 900,000, 90,000. All 05:06PM

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1 right. Let's clean it up. We did well with  
2 900,000. Let's approach it this way, Dr. Engel.  
3 Can you look at Page D-18 of your appendix?

4 MR. GEORGE: Actually let's take a break so  
5 we can change the tape out before we get into this 05:06PM  
6 page.

7 VIDEOGRAPHER: We're now off the Record.  
8 The time is 5:06 p.m.

9 (Following a short recess at 5:06 p.m.,  
10 proceedings continued on the Record at 5:21 p.m.) 05:20PM

11 VIDEOGRAPHER: We are back on the Record.  
12 The time is 5:21 p.m.

13 Q Dr. Engel, can you look at appendix Page D-18  
14 to your report?

15 A Okay. I'm on that page. 05:21PM

16 Q And does Appendix D-18 talk about the amount  
17 of poultry litter that was used in your simulations  
18 or modeling exercises?

19 A So, yes, that's what is being described.

20 Q And you see the figure 223,000 tons per year? 05:21PM

21 A Correct.

22 Q Okay. Is that figure -- does it represent the  
23 assumption that you made as to the amount of poultry  
24 litter that is applied on an annual basis in the  
25 Illinois River watershed? 05:22PM

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1 A So this value served as the starting point  
2 prior to calibration.

3 Q Okay. Let's stay with the starting point  
4 because that's the assumption you made initially,  
5 correct, 223,000? 05:22PM

6 A Correct.

7 Q And what was the basis for that 223,000  
8 figure?

9 A So this was the calculated weight based on  
10 Meagan Smith's mass balance report as was documented 05:23PM  
11 in my Appendix B.

12 Q Where did Meagan Smith get the 223,000 tons  
13 per year number?

14 A So I'm not misrepresenting this, let me take a  
15 quick look again to refresh my memory. 05:23PM

16 Q Sure.

17 A So this value would have been calculated based  
18 on the number of active poultry houses associated  
19 with the defendants within the IRW and data from  
20 nutrient management plans from the Eucha-Spavinaw 05:24PM  
21 watershed.

22 Q Did Miss Smith assume in computing this number  
23 based upon the number of houses in the watershed  
24 that all litter generated in the watershed was  
25 applied in the watershed? 05:24PM

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1 A Well, the mass balance would have represented  
2 this is the amount of phosphorus that moved into the  
3 watershed as a result of production of the poultry,  
4 and it does not speak to export of litter.

5 Q So then is the answer to my question yes, that 05:24PM  
6 this calculation assumes that all litter generated  
7 in the watershed stays in the watershed?

8 A This number would represent that all litter  
9 stays in the watershed.

10 Q Okay, and is that a realistic assumption, Dr. 05:25PM  
11 Engel?

12 A In recent years, no. Historically, yes.

13 Q Okay. Well, did this number, this initial  
14 starting value of 223,000 tons of poultry litter  
15 applied in the watershed per year, was it the same 05:25PM  
16 starting value for both your historical model runs  
17 and your forward or predictive model runs?

18 A You've got two cases there, right, so the  
19 historical -- what do you mean by the historical  
20 model runs? Could you make sure I'm clear on that? 05:25PM

21 Q Well, you have one set of model runs that are  
22 designed to simulate conditions between -- well, let  
23 me find them. Conditions over the last 50 years,  
24 correct, and what has caused those conditions?

25 A From 1950 to 1999? 05:26PM

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<p>1 are the correct years, that there have been some 2 effort to transport waste out of the watershed. 3 Q Okay. Now, so we don't get out on a rabbit 4 trail, I'm not asking you to make a calculation 5 based upon generation and then subtract what you 05:49PM 6 know has been exported. Okay? Let's set that aside 7 for a moment. I want to know if you, Dr. Engel, had 8 information available that demonstrated and 9 documented the actual amount of poultry litter that 10 is applied in the watershed as opposed to generated. 05:49PM 11 A Well, I had data that indicate -- well, I have 12 indirect data that one can use to calculate the 13 expected amount that would be land applied, and just 14 to carry that a step further, you know, because the 15 model is being calibrated, it's not necessary that 05:49PM 16 we have the exact 223,000 tons being applied at the 17 start of this. So because of the calibration 18 process, this is one of the items that's being 19 adjusted via calibration and, therefore, you know, 20 this is a detail that, you know, isn't necessary. 05:50PM 21 Q The actual amount land applied wasn't 22 necessary for your modeling work; is that right? 23 A We needed a reasonable starting point for the 24 amount being land applied. We had a reasonable 25 starting point for the amount being land applied. 05:50PM</p>	<p>1 up Arkansas producers. If you look at, you know, 2 the reports from -- multiple reports from Storm, 3 state agency reports, federal reports, the USGS 4 analysis, all of these sources including your own 5 Tyson's environmental practices handbook, indicate 05:53PM 6 that poultry waste is land applied and it's 7 typically land applied near where it's produced. 8 Q Okay. Dr. Engel, who do growers in the state 9 of Oklahoma, in the Oklahoma portion of this 10 watershed, report to in terms of the location and 05:53PM 11 amount of their litter application? 12 A You said the Oklahoma portion of this? 13 Q Yes, sir. 14 A My understanding is that, you know, they're 15 reporting data to ODAFF. 05:53PM 16 Q Okay, and you in Table 4.1 have tallied up 17 over a multiple year period the amounts of litter 18 that ODAFF has received reports on in terms of 19 litter application in the watershed; correct? 20 A Correct. 05:53PM 21 Q Okay, and these numbers, by the way, if you 22 look at the inside Illinois River watershed in terms 23 of tons, those numbers reflect a combination of 24 multiple years' worth of reports; correct? 25 A I believe that's the case. 05:54PM</p>
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<p>1 That was the value that was used. That doesn't 2 impact the conclusions. That doesn't impact the 3 opinions that were reached. 4 Q Can you look in your report at Pages 19 and 5 20, Tables 4.1 and 4.3? Dr. Engel, you actually had 05:50PM 6 available to you, did you not, and you've set out in 7 these two tables in your report the results of your 8 review of records regarding actual land applications 9 in the watershed; correct? 10 A Well, so -- okay. So on Pages 19 and 20? 05:51PM 11 Q Uh-huh. 12 A So pages -- the tables on Pages 19 and 20 -- 13 well, let me start with the table on Page 19. So 14 this table is identifying via ODAFF records the 15 amount of waste that was generated within the IRW 05:51PM 16 and whether it was applied inside, on the border or 17 outside of the IRW. I would take that a step 18 further and indicate that by no means are the ODAFF 19 records complete and by no means do those represent 20 the entirety of waste that would have been land 05:52PM 21 applied within the watershed. 22 Q How do you know that? 23 A Well, again, if you look at the literature, if 24 you look at nutrient management plans from producers 25 in Arkansas, this is ODAFF data so it doesn't pick 05:52PM</p>	<p>1 Q Okay. Do you recall how many years? 2 A Not without looking at some background data. 3 Q All right. We don't have time to look. Turn 4 to the next page, Table 4.3. On the Arkansas side 5 of the basin, who receives reports in terms of 05:54PM 6 regulatory body on the amount of poultry litter 7 that's applied by Arkansas growers? 8 A As I recall, the ANRC has some data. It's not 9 a dataset that allows one to readily see via the 10 data that's available and reported to see where all 05:54PM 11 the waste is land applied. 12 Q All right. So in Table 4.3, do I understand 13 that you've summarized the information provided by 14 the Arkansas regulator in terms of the amount of 15 poultry litter applied in four years, from 2004 to 05:55PM 16 2007, in the Arkansas portion of the basin? 17 A What were the years? 18 Q 2004 through 2007. 19 A Oh, is that what it says? 20 Q Table 4.3. 05:55PM 21 A Oh, yes. 22 Q Okay. So, Dr. Engel, if you added up any 23 given year's worth of data in terms of the actual 24 records of documented litter application in the 25 watershed from the two regulatory agencies, would 05:55PM</p>

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<p>1 you ever get a year that reflects 354,000 tons of 2 documented land application of poultry litter? 3 MR. GARREN: Object to the form. 4 A These two tables and those two datasets don't 5 represent all of the waste that's been land applied. 05:55PM 6 Q And how do you know that? 7 A You can look at nutrient management plans. 8 You can look at literature. You can look at other 9 scientific reports cited in the earlier parts of 10 this chapter and, in fact, your own experts want to 05:56PM 11 be -- want you to be compensated for the amount of 12 waste that's being land applied. Rouser and Dicks 13 assume every bit of it is land applied, and they 14 assume every bit of it has been land applied 15 historically. 05:56PM 16 Q Are you basing your opinion on the opinion of 17 Rouser and Dicks, Dr. Engel? 18 A That's one place, one among many sources. 19 Q Do you consider them to be reliable sources of 20 information? Well, you wouldn't rely on an 05:56PM 21 unreliable source, would you? 22 MR. GARREN: Object to form. 23 A Their assumption regarding land application of 24 waste, I think they are correct with that 25 assumption. 05:57PM</p>	<p>1 tons of poultry litter wet that are generated are 2 applied in the watershed; is that right? 3 MR. GARREN: Object to form. 4 A Well, again, there's ample evidence in the 5 literature and in the reports that I mentioned in 05:58PM 6 other modeling studies that have been done on this 7 watershed, you know, that indicate that that is a 8 valid assumption. 9 Q Okay. You believe that to be a good 10 assumption; right? 05:58PM 11 A I guess we're talking about an assumption that 12 would be well accepted and is well supported by the 13 literature, well accepted by the scientific 14 community. 15 Q Okay. So, Dr. Engel, despite all that, how 05:58PM 16 well accepted you believe your assumption is, if 17 that assumption is markedly off in terms of reality, 18 that affects the output of your model; right? 19 A What do you mean by markedly off? 20 Q Let's say in reality there is only 200,000 05:59PM 21 tons of poultry litter applied in the watershed each 22 year. Would that affect the outcome of your model? 23 A If it were that low? 24 Q If it were that low, yes. 25 A Well, I mean, if it were -- we can't have the 05:59PM</p>
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<p>1 Q So you believe they make reasonable 2 assumptions in their analyses then? 3 MR. GARREN: Object to form. 4 A That carries my statement a little further 5 than I think I would carry it. 05:57PM 6 Q All right. I think the only data source that 7 you identified in your list of things, other than 8 records, was nutrient management plans. Did you 9 tally up the values reported in nutrient management 10 plans for all growers in this watershed in terms of 05:57PM 11 the amount of poultry litter that's being applied? 12 A I didn't have access to all nutrient 13 management plans for this watershed, nor does anyone 14 else to my knowledge have access to all nutrient 15 management plans for the watershed. So, yes, I 05:57PM 16 think that's a mischaracterization of, you know, 17 what the reality might be. 18 Q All right, but you didn't do it because you 19 didn't have that data available; right? 20 A Right. 05:57PM 21 Q And in the absence of data in modeling, 22 sometimes you have to make assumptions; right? 23 A Yes. 24 Q And one of the assumptions that was made in 25 your modeling work was that in each year the 354,000 05:58PM</p>	<p>1 soil test phosphorus levels that we currently see in 2 this watershed with all these assumptions you are 3 wanting to make. So stepping back as a modeler, you 4 have to look at the data that's there. You're not 5 looking at one piece of data when you're making 05:59PM 6 these decisions, and you're looking at the soil test 7 phosphorus and you say, well, that's high, how did 8 it become high. Everything points to land 9 application of poultry waste as to the reason that 10 that has become high. In fact, I think Mr. Ryan, in 06:00PM 11 representing Tyson in the preliminary injunction, 12 indicated that poultry waste had been over applied 13 in many instances in the watershed. So, you know, 14 there are numerous sources that point to this being 15 a valid assumption and an assumption that, you know, 06:00PM 16 any reasonable modeler would make. 17 Q Move to strike, non-responsive. Dr. Engel, 18 another assumption that you made in your modeling, 19 is that all parcels of land identified in your 20 dataset as pasture in the Illinois River watershed 06:00PM 21 received poultry litter each year; is that right? 22 A That's correct. 23 Q What was the basis for that assumption? 24 A Well, knowing how the model works and 25 understanding that we needed to allocate poultry 06:00PM</p>

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<p>1 waste to the landscape, an appropriate assumption  2 was to apply that poultry waste to all pasture areas  3 each year. So the net impact of that on the ability  4 to model the phosphorus reaching the three gauging  5 stations, the ability to model the phosphorus 06:01PM  6 attributable to each source was negligible. So, in  7 fact, that assumption benefits the defendants. You  8 know, that assumption puts low amounts of  9 phosphorus, low amounts of waste on the pasture.  10 The model is going to indicate that higher amounts 06:01PM  11 are more susceptible to runoff and movement.  12 Literature suggests the same, and so by applying  13 these lower amounts, you know, the net effect of  14 that assumption was to underestimate the poultry  15 contribution to phosphorus runoff. 06:02PM  16 Q Dr. Engel, do you believe that all mistakes  17 that were made in your modeling should be excused if  18 they benefit the defendants?  19 MR. GARREN: Object to form.  20 A Assumptions -- the assumption we just talked 06:02PM  21 about in applying poultry litter to all pastures is  22 not a mistake. That was an assumption, not a  23 mistake.  24 Q Okay, but you will agree with me that if your  25 assumption is unrealistic, then it can affect 06:02PM</p>	<p>1 watershed?  2 A For the purposes of the model study, it wasn't  3 necessary to reflect the actual spreading patterns.  4 So the answer to your question is, no, it doesn't  5 reflect the exact application patterns but it's not 06:04PM  6 necessary to reflect the exact application patterns,  7 for this scale of analysis for the questions that  8 were being asked.  9 Q Who says it's not necessary; you?  10 A As a modeler and based on my professional 06:04PM  11 experience and judgment, yes, and if we look in the  12 literature, again, we're going to find that this is  13 a very commonplace assumption. If we look at the  14 USGS reports that identified trends between  15 increased phosphorus loads and livestock that 06:05PM  16 included poultry land application, they didn't  17 allocate that. You know, they were working at  18 scales comparable to the gauges on the IRW. They  19 found trends. You know, it's not necessary to  20 represent what you're suggesting I should have done. 06:05PM  21 It wasn't necessary.  22 Q Okay. Let's get out of model work for a  23 moment and get into reality. You do agree with me,  24 as a matter of reality, that not all pastures in the  25 Illinois River watershed receive poultry litter 06:05PM</p>
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<p>1 whether or not the results from your model are  2 realistic; right?  3 MR. GARREN: Object to form.  4 A Well, one has to know how these assumptions  5 propagate through the model. So, you know, if I 06:03PM  6 assumed all the phosphorus was applied in a small  7 area, yeah, that would be a really bad assumption.  8 If I assume because I understand how the model works  9 and I understand the equations and the theory in the  10 model, by spreading it across all pasture, I'm able 06:03PM  11 to estimate phosphorus movement from the watershed.  12 I'm able to estimate that so that it matches the  13 observed data, and the net impact of that is that  14 I'm allocating less phosphorus loss to poultry than  15 what reality would be based on the documented waste 06:03PM  16 application processes within the watershed.  17 Q It's your testimony, Dr. Engel, that your  18 assumption that more pastures receive poultry litter  19 in your modeling than actually receive poultry  20 litter in the real world is an assumption that 06:04PM  21 benefits the defendants; is that right?  22 A Yes.  23 Q Okay. Is it a realistic assumption in terms  24 of reflecting the conditions and land uses and  25 application practices that actually exist in the 06:04PM</p>	<p>1 every year?  2 A I would agree with that statement.  3 Q Okay. Another assumption, Dr. Engel, that you  4 made in your modeling work is that all 354,000 tons  5 of poultry litter generated in this watershed was 06:06PM  6 applied on a single day each year; is that right?  7 A That's correct.  8 Q Okay, and what day was that, at least in your  9 initial model setup?  10 A I believe that was the first of March or so. 06:06PM  11 Q Look at the bottom of D-18, Dr. Engel.  12 A Looks like the 1st of April.  13 Q So in the initial setup of your model in this  14 case, you assumed that all 354,000 tons of poultry  15 litter went down in one event on April 1st on all 06:06PM  16 pastures in the watershed; is that right?  17 A That's correct.  18 Q Okay. Now, Dr. Engel, you do agree with me,  19 do you not, that the season and timing of  20 application, particularly in reference to rainfall, 06:07PM  21 can affect the amount of phosphorus that is lost  22 from a field?  23 A It can.  24 Q Okay, and you do agree with me, do you not,  25 Dr. Engel, that in the real world, not the model 06:07PM</p>

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<p>1 narrow point. If there's a cattle in the watershed  2 grazing on a pasture that has 500 pounds per acre  3 phosphorus, does that cow excrete more phosphorus  4 than a cow grazing on a pasture in the watershed  5 that has 65 pounds per acre phosphorus? 09:25AM  6 A Based on the earlier conversation, it may  7 excrete a little more because, again, from some  8 literature I've seen, it does seem to be some  9 potential for forages and grasses to use a little  10 more phosphorus. However, again, you know, if the 09:25AM  11 phosphorus were not at 500, that number of cattle  12 would likely be fewer. So it's tough to answer this  13 hypothetical question.  14 Q Okay. You do agree, Dr. Engel, that in the  15 example that we just went through, the cow on the 09:26AM  16 500 pound per acre field would not excrete  17 significantly more phosphorus than the cow on the 65  18 pound per acre field?  19 A We're talking about one cow?  20 Q Yes, sir. 09:26AM  21 A Yeah, I would concur.  22 Q Okay. Is it your understanding that this  23 lawsuit is about reducing the number of cattle in  24 the watershed?  25 MR. GARREN: Object to form. 09:26AM</p>	<p>1 fertilizer that is applied in the watershed in a  2 year?  3 A I'm not sure I quite follow the question.  4 Could you --  5 Q Well, let me ask it a different way. Is it 09:28AM  6 your belief, Dr. Engel, or understanding that only  7 455 tons of phosphorus from commercial fertilizer  8 hit the ground in the watershed each year?  9 A So my understanding is that this is the  10 commercial fertilizer sold that through the analysis 09:29AM  11 that Meagan Smith did, I believe in consultation  12 with Gordon Johnson, and maybe even Gordon did that  13 analysis, his calculated value of commercial  14 fertilizer sold, I think this is a sold value, and  15 presumably that's land applied within the watershed, 09:29AM  16 is the 455 tons for 2002.  17 Q Dr. Engel, do users of commercial fertilizer  18 in the watershed buy commercial fertilizer from  19 outside the watershed?  20 A They potentially do. 09:29AM  21 Q The lawn care companies operating in northwest  22 Arkansas, do you know, Dr. Engel, do they buy their  23 fertilizer from outside the watershed and then apply  24 it inside the watershed?  25 A I don't know if they do or don't. 09:30AM</p>
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<p>1 A It may have -- it has the potential to have  2 that impact I suppose, but I don't think that's  3 the -- that's not the central theme. You know, the  4 goal here is to improve the quality of water in the  5 streams and rivers and in Lake Tenkiller and improve 09:27AM  6 the biological activity and recreational uses of  7 those waters.  8 Q Let's go back to D-19 of your report. We were  9 talking about some of these inputs of phosphorus  10 from sources other than poultry litter that came 09:27AM  11 from Miss Smith's mass balance analysis.  12 A Yes.  13 Q And one of the inputs is commercial  14 fertilizer, 455 tons of phosphorus; do you see that?  15 A I'm having trouble with my binder here. I'm 09:27AM  16 sorry.  17 Q That's okay. D-19, Doctor.  18 A Yes.  19 Q That figure for commercial fertilizers also  20 comes from Table 29 of Miss Smith's mass balance 09:28AM  21 report; correct?  22 A Correct.  23 Q All right. How does that figure of 455 tons  24 of phosphorus from commercial fertilizer compare to  25 the actual amount of phosphorus from commercial 09:28AM</p>	<p>1 Q What did you do to try to discover the reality  2 of the relationship between where fertilizer is  3 purchased and where it is applied in this watershed?  4 MR. GARREN: Object to form.  5 A I didn't do anything specifically to collect 09:30AM  6 data from this specific location because, again,  7 based on my professional experience, you know, this  8 is not a significant source of the phosphorus that  9 ultimately reaches the streams, rivers and Lake  10 Tenkiller. So because it wasn't a significant 09:30AM  11 source, you know, it wasn't necessary to represent  12 that very minor level of detail that would have very  13 minor impact in the results and would have no impact  14 in the conclusions.  15 Q Dr. Engel, how do you know if a source is 09:31AM  16 significant if you don't quantify it?  17 A One doesn't have to calculate absolute numbers  18 and calculate, you know, the fertilizer to the  19 nearest ton to know that it's not going to be a  20 significant source. You know, if you want to make 09:31AM  21 some assumptions about how much phosphorus is  22 applied to, you know, to the lawn care or by the  23 lawn care industry, you know, a quick analysis of  24 that indicates that, you know, that's  25 inconsequential compared to the, you know, 4,500 09:31AM</p>

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<p>1 or value in the input files that has the title rate,  2 and I'm wondering, does that input parameter reflect  3 the rate of poultry litter application only or the  4 rate of all animal waste being applied to the  5 surface of the land; do you understand that 09:44AM  6 question?  7 A Right. So, again, without seeing the specific  8 value, given that Dr. Ji-Hong was setting those up  9 and running, I've looked at some of that, but  10 without reviewing that and providing some further 09:45AM  11 context, I'm not sure I can answer the question as  12 I'm sitting here.  13 Q That's another one I'll warn you, I'll  14 probably want an answer to before we leave. So if  15 there's something you can look at on a break or a 09:45AM  16 call you can make, I would strongly encourage you to  17 do that. Dr. Engel, do you -- strike that. Was it  18 your intent to treat poultry litter and other animal  19 manure as an input separately in the modeling?  20 A I believe that at least initially it was. 09:45AM  21 Ultimately, you know, it's possible they were  22 combined. Again, without looking, I'm not certain.  23 Q Dr. Engel, if you combined all animal waste,  24 not just poultry litter but cattle manure and dairy  25 effluent and swine manure into a single input 09:46AM</p>	<p>1 terms of acreage?  2 A In terms of total acres, each -- I'm not  3 certain. If we looked with respect to pasture  4 acres, those are shown in -- on D-18.  5 Q Okay. They're shown as hectares, aren't they? 09:47AM  6 A Yes.  7 Q What is a hectare?  8 A So a hectare would be -- is it 2.47 acres? I  9 would need to probably look at that conversion to  10 make sure I've got that right. 09:48AM  11 Q I think you're right, but maybe you could, if  12 you still have your calculator with you, convert the  13 acreage of pasture in each of those zones shown on  14 Page D-18 to acres using that conversion factor.  15 A Okay. I've done the conversions. 09:48AM  16 Q Okay, and could you tell me how much acreage  17 in terms of pastureland you have represented in the  18 model for Zone 1?  19 A So the 47,720 hectares is using 2.47 as a  20 conversion. 117,868 acres. 09:51AM  21 Q Okay. Now --  22 MR. ELROD: How many was that?  23 A 117,868.  24 MR. ELROD: Thank you.  25 Q Now, Dr. Engel, in terms of application rate 09:51AM</p>
Page 317	Page 319
<p>1 parameter, would that not complicate your ability to  2 allocate back sources of phosphorus to just poultry?  3 MR. GARREN: Object to form.  4 A If those are combined, that does -- that would  5 certainly complicate it. 09:46AM  6 Q Well, let's talk for a moment about the rate  7 of application for poultry litter. Okay?  8 A Okay.  9 Q And you've got some calculations on Page D-18  10 that all begin with this 223,000 tons. Do you see 09:46AM  11 that?  12 A Yes.  13 Q Okay. Now, you had different application  14 rates for pastures in different zones of the  15 watershed; correct? 09:46AM  16 A Correct.  17 Q And why is that?  18 A The -- excuse me. The density and  19 distribution of poultry houses varied throughout the  20 watershed. 09:47AM  21 Q So is there embedded in that the assumption  22 that litter is applied more heavily in more densely  23 populated areas in terms of poultry houses?  24 A Correct.  25 Q How large are these zones, these four zones in 09:47AM</p>	<p>1 across all 117,868 acres in Zone 1 of the Illinois  2 River watershed, in your modeling did you assume the  3 application rates on each acre were constant?  4 A Yes.  5 Q Okay. So every one of those 117,868 acres 09:51AM  6 received the exact same amount of poultry litter; is  7 that right?  8 A It should have, yes.  9 Q Okay. Is that consistent with reality in  10 terms of what happens with poultry litter in the 09:51AM  11 Illinois River watershed?  12 MR. GARREN: Object to form.  13 A In reality, in a given year it's probably  14 applied on less than that total acreage. So, again,  15 the impact of that on the model, given that the 09:52AM  16 model is being calibrated, though, to match the  17 extensive set of observed data is insignificant.  18 Q Well, let's stay away from total -- well,  19 strike that. With respect to the rate of  20 application, do you agree that there is variation 09:52AM  21 within Illinois River watershed, including within  22 Zone 1, as to the number of pounds or tons of  23 poultry litter that are applied to an acre?  24 A Yes, there would be.  25 Q Some farmers apply at one rate and other 09:52AM</p>

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1	Q Sure.	1	model is typically calibrated first to obtain
2	MR. ELROD: 65 percent.	2	acceptable performance in the hydrologic components,
3	A It's 65 percent, so we're going to divide by	3	then for sediment and finally for nutrients,
4	.65 I believe, but let me double check that. Looks	4	pesticides, bacteria or other constituents; do you
5	like the actual value that was used was 63 percent. 10:02AM	5	see that? 10:08AM
6	Looks like I calculated that by hand yesterday and	6	A Yes.
7	it should be 63 percent. So if we divide these	7	Q Okay, and is that describing the general order
8	values by .63, we'll get the expected tons as	8	in which you typically calibrate a model; that's the
9	applied.	9	sequence you ordinarily follow?
10	Q Okay. Could you, and I apologize, could you 10:02AM	10	A That would be pretty typical, yes. 10:08AM
11	do that for each of the litter application rates	11	Q Okay, and, Dr. Engel, did you calibrate the
12	that you've calculated for the four zones starting	12	GLEAMS model for sediment?
13	with Zone 1?	13	A No.
14	A Okay.	14	Q Why not?
15	Q If it helps, you told me four tons per acre 10:03AM	15	A Based on the observed sediment information 10:08AM
16	for Zone 1 dry.	16	within the watershed and that was reaching Lake
17	A So it looks like that one would be 0.63 tons	17	Tenkiller, my judgment was that sediment was not
18	per acre.	18	significant pathway in movement of phosphorus
19	Q Okay. So 2 converted to wet, please.	19	through -- through the -- through the system to Lake
20	A So that one would be 0.54 tons per acre. 10:03AM	20	Tenkiller. 10:09AM
21	Q Thank you.	21	Q What particular data or information did you
22	A Zone 3 would be 1.05 tons per acre.	22	look at, Dr. Engel, that told you that sediment was
23	Q Thank you.	23	not a significant pathway for the movement of
24	A Looks like Zone 4 would be 0.16 tons per acre.	24	phosphorus through this system to Lake Tenkiller?
25	Q Okay. Thank you. Dr. Engel, I'm going to 10:04AM	25	A Well, the core data from Lake Tenkiller 10:09AM
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1	hand you what I've identified as Exhibit 15, which	1	suggests that the amounts of sediment reaching
2	is a map of your four zones, and I've been recording	2	Tenkiller are relatively low and, in fact, quite
3	the calculations you've given me, and I'm just going	3	low. So that was -- that would have been the
4	to ask you to take a look at Exhibit 15 and tell me	4	initial piece of data that was examined. I guess
5	whether it reasonably reflects the assumptions, at 10:05AM	5	that was reinforced with -- subsequent to the report 10:10AM
6	least in terms of initial model setup, that you made	6	with a study that USGS had provided that indicated
7	as to the numbers of acres of pasture in each zone	7	the sediment loads at Tahlequah, as I recall, at
8	that receives poultry litter and the rate, both wet	8	Tahlequah. So that was a USGS report that I believe
9	and dry, of application of poultry litter assumed in	9	we were talking about yesterday.
10	those zones. 10:05AM	10	Q You referenced some core data. What do you 10:10AM
11	A Yes, this represents the conversation we've	11	mean by core data?
12	just had.	12	A The sediment cores, not the Army Corps of
13	Q Bear with me. I've misplaced something. Can	13	Engineers, but the sediment cores that were taken as
14	you find your modeling protocol articles in the	14	part of this study.
15	stack of exhibits that's in front of you? 10:07AM	15	Q Okay, and how was it that by examining that 10:11AM
16	MR. GARREN: Exhibit 11, Counsel?	16	data, Dr. Engel, you came to the conclusion that
17	MR. GEORGE: If you say so.	17	sediment is not a significant pathway for phosphorus
18	MR. GARREN: Is that it?	18	in this watershed?
19	MR. GEORGE: It is, yes.	19	A Well, based on the amount of deposition within
20	MR. GARREN: All right. 10:07AM	20	the lake and the time period over which that 10:11AM
21	A Okay. I've got Exhibit 11.	21	occurred, the anticipated -- the erosion rates would
22	Q If you look at the very bottom of Page 1231 of	22	be, as I recall, less than half a ton per acre per
23	Exhibit 11 of your article, you'll see the last	23	year. So the -- it may even be less than that. So
24	sentence on the page that begins with the word the	24	the sediment loads, based upon the observed core
25	and then carries over. In your article you say, the 10:08AM	25	data and the period over which that was deposited, 10:11AM

17 (Pages 324 to 327)

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<p style="text-align: right;">Page 336</p> <p>1 Q Okay, because you're trying to get at if I 2 understand -- you can tell me if I'm wrong. You're 3 trying to get at the Delta, if you will, with 4 poultry litter and without poultry litter; right? 5 A Correct. 10:36AM 6 Q Okay, and if you changed other things that are 7 unrelated to poultry litter, such as the amount of 8 animal waste and commercial fertilizer that hits the 9 ground, then the difference or the Delta would be 10 off; right? 10:36AM 11 A Yeah. It would potentially be off. 12 Q Okay. So there should be in your GLEAMS input 13 files for the 100-year no waste plus background soil 14 P scenarios input values for commercial fertilizer 15 and non-poultry animal wastes; right? 10:36AM 16 A I would have to look to be sure but -- 17 Q But there should be? 18 A I believe there should be. 19 Q All right. Now, how did you use -- strike 20 that. Did you use the results of this 100-year no 10:37AM 21 waste plus background scenario in your methodology 22 for allocating the phosphorus loads to poultry 23 litter that are shown as relative contribution 24 percentages in Opinion No. 8 on Page 2 of your 25 report? 10:37AM</p>	<p style="text-align: right;">Page 338</p> <p>1 Q And do you see that you list some requirements 2 in the modeling plan that should be met beginning on 3 Page 1223 and continuing over to 1224. They're 4 numbered one through seven I think. 5 A Okay. 10:42AM 6 Q Can you read for the Record what you said was 7 a necessary part of a modeling plan in your article 8 at No. 5? 9 MR. GARREN: Object to the form. 10 Q Can you read No. 5? 10:42AM 11 A Well, this seems to be a list that's 12 referenced from an EPA publication. So this seems 13 to be an EPA list, and which number again? I'm 14 sorry. 15 Q No. 5. 10:42AM 16 A No. 5, clear documentation of assumptions, 17 theory and parameterization that is detailed enough 18 so others can fully understand the model 19 predictions. 20 Q Did you meet that standard in your report in 10:42AM 21 this case with respect to the basis for Opinion No. 22 8? 23 MR. GARREN: Object to form. 24 A There probably could have been more 25 documentation in the document to describe that but, 10:43AM</p>
<p style="text-align: right;">Page 337</p> <p>1 A Yes. That background would have been used in 2 that set of computations. 3 Q Okay. Now, Dr. Engel, can you show me 4 anywhere in your report where you explain how you 5 actually arrived at the 45 percent and 59 percent 10:38AM 6 relative contribution allocation to poultry litter 7 that is expressed in Opinion 8 in your report. 8 A I'm not seeing much of a description of 9 process up there. 10 Q Okay, and, Dr. Engel, why is that? 10:40AM 11 A Looks like that may have been something that 12 was not fully addressed in the rush to meet the 13 deadline. 14 Q You weren't playing hide the ball on the basis 15 for your Opinion No. 8, were you? 10:41AM 16 A That certainly wasn't the intent. 17 Q Dr. Engel, you do appreciate, do you not, that 18 Opinion No. 8 as to the relative contribution of 19 poultry litter to the phosphorus load at Lake 20 Tenkiller is an important opinion in this case? 10:41AM 21 A It's an important opinion and it is consistent 22 with what others have found. 23 Q Okay. Do you have Exhibit 11 with you, your 24 article on modeling protocol? 25 A Okay. 10:41AM</p>	<p style="text-align: right;">Page 339</p> <p>1 you know, there are plenty of underlying materials 2 that have, you know, that have that information that 3 was relied upon. 4 Q Can do you identify those other materials 5 anywhere in your report so that someone wanting to 10:43AM 6 investigate the basis for your opinion and the 7 reliability of your work related to that opinion 8 could easily find those materials? 9 MR. GARREN: Object to form. 10 A Well, there are, you know, again, very large 10:44AM 11 numbers of files that were used in this process, and 12 certainly not every single one of those is fully 13 documented. 14 Q Is that, no, you didn't identify the materials 15 that were used to support Opinion No. 8 in your 10:44AM 16 report? 17 MR. GARREN: Object to form. 18 A Well, so materials are not clearly identified 19 by the report. 20 Q Dr. Engel, could you turn to Page 93 of your 10:44AM 21 report? 22 A Okay. 23 Q Do you see on page -- strike that. Page 93, 24 Dr. Engel, I'll represent to you, is the only place 25 that I've been able to find in your report that 10:45AM</p>

20 (Pages 336 to 339)

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<p>1 seems to relate to these 45 percent and 59 percent</p> <p>2 figures that you express in Opinion No. 8. Can you</p> <p>3 tell me with respect to Table 10.14, which is</p> <p>4 entitled IRW P Load Allocation to Sources, the</p> <p>5 source of the data that is contained in that table? 10:45AM</p> <p>6 A Well, this would represent a summary of a</p> <p>7 large amount of underlying data. So it's a summary</p> <p>8 of numerous other spreadsheets of data.</p> <p>9 Q Can you point me to the spreadsheets that form</p> <p>10 the basis for Table 10.14? 10:46AM</p> <p>11 A Without, again, looking through the materials</p> <p>12 carefully to see how those came together, you know,</p> <p>13 I can't as I'm sitting here at the moment.</p> <p>14 Q Okay. Are the values that are reflected in</p> <p>15 Table 10.14 for wastewater treatment plant, forest, 10:46AM</p> <p>16 crop, urban and pasture, are those the product of</p> <p>17 output of the GLEAMS model?</p> <p>18 A So wastewater treatment is simply the</p> <p>19 calculation of the wastewater treatment plant</p> <p>20 inputs. 10:47AM</p> <p>21 Q Well, let me stop you there. The value under</p> <p>22 wastewater treatment plant is the number 30. What</p> <p>23 does that mean?</p> <p>24 A I'm sorry. That's 30 percent.</p> <p>25 Q Okay. How did you get 30 -- strike that. 10:47AM</p>	<p>1 right?</p> <p>2 A Correct.</p> <p>3 Q Okay. Now, the values beneath these four land</p> <p>4 use categories, for example, forest, is one and one.</p> <p>5 Is that percentage again? 10:48AM</p> <p>6 A These would all represent percentages.</p> <p>7 Q Okay, and crop is less than one; correct?</p> <p>8 A Yes.</p> <p>9 Q And urban is 7, and pasture is 62 percent in</p> <p>10 one instance and 76 percent in another; is that 10:49AM</p> <p>11 correct?</p> <p>12 A Correct.</p> <p>13 Q Now, Dr. Engel, when you run GLEAMS, does it</p> <p>14 spit out a percentage of the phosphorus load that is</p> <p>15 attributable to these four land uses? 10:49AM</p> <p>16 A It, you know, provides data about the</p> <p>17 phosphorus loads, and that data was used to compute</p> <p>18 the percentages.</p> <p>19 Q Does it provide a total load that GLEAMS</p> <p>20 believes is attributable to each of the four land 10:49AM</p> <p>21 uses that are shown in Table 10.14?</p> <p>22 MR. GARREN: Object to form.</p> <p>23 A It provides total loads of phosphorus that</p> <p>24 would have been -- that would have to be summed to</p> <p>25 arrive at a total. 10:49AM</p>
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<p>1 Does the 30 percent allocation of phosphorus to</p> <p>2 wastewater treatment plants come from either the</p> <p>3 GLEAMS model or your routing model; did they spit</p> <p>4 out a percentage like that when you run the model?</p> <p>5 A No. The model is not providing that 10:47AM</p> <p>6 percentage.</p> <p>7 Q Okay.</p> <p>8 A So that was calculated.</p> <p>9 Q Calculated outside of the model; correct?</p> <p>10 A Correct. 10:47AM</p> <p>11 Q Outside of both models; correct?</p> <p>12 A Both models being --</p> <p>13 Q GLEAMS and the routing model.</p> <p>14 A Yes.</p> <p>15 Q And that calculation was performed by who? 10:47AM</p> <p>16 A Well, there were portions of that performed by</p> <p>17 Dr. Ji-Hong and portions of that performed by</p> <p>18 myself. So the ultimate calculation of the 30</p> <p>19 percent would have been a calculation that I did.</p> <p>20 Q Now, the next four categories in Table 10.14, 10:48AM</p> <p>21 forest, crop, urban and pasture, are all land uses,</p> <p>22 are they not?</p> <p>23 A Yes.</p> <p>24 Q Okay, and these four land uses are land uses</p> <p>25 that are simulated in the GLEAMS model; is that 10:48AM</p>	<p>1 Q Okay, and it would do that for each of those</p> <p>2 four land uses; right?</p> <p>3 A Well, it would provide the outputs and someone</p> <p>4 would need to sum those.</p> <p>5 Q What outputs would have to be summed? Is it 10:50AM</p> <p>6 a -- I'm sorry. Do you have an output for each zone</p> <p>7 that you have to sum?</p> <p>8 A Well, there would be -- there would be outputs</p> <p>9 for each hydrologic response unit that would need to</p> <p>10 be summed. 10:50AM</p> <p>11 Q And every one of your hydrologic response</p> <p>12 units is classified as one of these four land types;</p> <p>13 right?</p> <p>14 A They would have one of those types, yes.</p> <p>15 Q So GLEAMS will give you the output of total 10:50AM</p> <p>16 phosphorus that's predicted coming off of each of</p> <p>17 the HRUs for forest; is that right?</p> <p>18 A Yes.</p> <p>19 Q And then you have to add all of those up;</p> <p>20 right? 10:50AM</p> <p>21 A That would be correct.</p> <p>22 Q Now, I don't see in the output descriptions</p> <p>23 here from GLEAMS in Table 10.14 a source that is</p> <p>24 identified as poultry litter. Do you?</p> <p>25 A I agree. 10:51AM</p>

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<p>1 Q Okay. So is it true, Dr. Engel, that GLEAMS 2 does not have the ability in and of itself to 3 predict the amount of phosphorus that is originating 4 from poultry litter as opposed to forest, crop, 5 urban and pasture? 10:51AM</p> <p>6 MR. GARREN: Object to form.</p> <p>7 A Well, the model, without interpreting the 8 results, you know, is not identifying poultry litter 9 as the phosphorus source. So, you know, it's going 10 to require one's interpretation of those results in 10:52AM 11 order to, you know, to arrive at a poultry 12 contribution.</p> <p>13 Q Okay. Just so our Record is clear, when you 14 run your GLEAMS model and your routing model for 15 that matter, you do not get an output from the 10:52AM 16 computer that says here is the percentage of 17 phosphorus load that is attributable to the source 18 poultry litter; right?</p> <p>19 MR. GARREN: Object to form.</p> <p>20 A So the model doesn't provide that but, again, 10:52AM 21 the model provides output data that can be used to 22 calculate that portion. So this isn't different 23 than the approach that other models would take.</p> <p>24 Q Which one of the land uses that GLEAMS can 25 simulate did you use and focus on in deriving your 10:53AM</p>	<p>1 A Could that be reread, please?</p> <p>2 Q Sure.</p> <p>3 MR. ELROD: When the witness asks his own 4 question to be reread, you know he's getting into 5 the project. 10:55AM</p> <p>6 (Whereupon, the court reporter read 7 back the previous question.)</p> <p>8 A So this was not -- this was not unique or 9 specific to GLEAMS. This was the same process that, 10 you know, Dan Storm and others have used with SWAT 10:55AM 11 in identifying a poultry contribution. So it's not 12 a unique process or method.</p> <p>13 Q Dr. Engel, point me to the piece of scientific 14 literature or a report by any other scientist where 15 the same methodology or computational approach was 10:56AM 16 used by anyone other than Dr. Engel ever before in 17 the history of man to break the pasture output from 18 any model down to a poultry number and a number that 19 reflects other sources.</p> <p>20 MR. GARREN: Object to form. 10:56AM</p> <p>21 A Were unique to GLEAMS or any model -- you said 22 any model? My recollection is that, you know, the 23 Storm effort in Eucha-Spavinaw is an example of 24 something, if not identical, very similar.</p> <p>25 Q Is it identical? 10:56AM</p>
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<p>1 45 and 59 percent phosphorus allocation to poultry?</p> <p>2 A So this would have, as identified here, come 3 out of the portion that's pasture.</p> <p>4 Q So we're clear, Dr. Engel, you took the 5 pasture prediction from GLEAMS in terms of 10:53AM 6 phosphorus that comes off of pastures and you had to 7 develop a methodology to break that pasture load 8 down to a poultry portion and then other portions; 9 is that right?</p> <p>10 A You know, describing that as development of a 10:53AM 11 methodology is probably an overstatement of what was 12 required. So it was, you know, a computation that 13 was done, you know, much like any computation you 14 would do with another model. So it wasn't 15 development of a new methodology. 10:54AM</p> <p>16 Q Who decided how the computation would be done 17 to break pasture down into poultry and other source?</p> <p>18 A I did.</p> <p>19 Q Okay, and did you derive that computation from 20 a piece of scientific literature somewhere where 10:54AM 21 someone else, some other scientist had taken the 22 output from GLEAMS on pasture and broken it down 23 between poultry and other sources?</p> <p>24 A There really wasn't much to derive here, so --</p> <p>25 Q Can you answer my question first? 10:54AM</p>	<p>1 A Without reviewing that report --</p> <p>2 Q Tell me Dr. Storm's methodology there as you 3 understand it.</p> <p>4 A Well, the concept would be -- and this is more 5 of a concept than a process or method. We're trying 10:57AM 6 to find the Delta, as you described earlier, that's 7 attributable to a specific source, and so, you know, 8 the concept is you take the model outputs with the 9 variable interest turned on. Then you take the 10 model outputs with that variable turned off. In 10:57AM 11 this case, poultry waste application. In this case, 12 though, too, one has to turn back soil test 13 phosphorus because part of the contribution of 14 poultry waste to the phosphorus being lost would be 15 due to that increased soil test phosphorus. So by 10:57AM 16 turning those off and looking at this difference, 17 you know, the interpretation of that is that, you 18 know, that must be the amount of phosphorus in this 19 particular case that would be attributable to 20 poultry. 10:58AM</p> <p>21 Q Did Dr. Storm break his pastureland use 22 category down using the same computations or methods 23 that you used as shown on Table 93 -- I'm sorry, 24 Page 93?</p> <p>25 A Well, certainly his computation would have 10:58AM</p>

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<p>1 been different. The methods may have been a little</p> <p>2 bit different, as he was using a different model.</p> <p>3 Q Dr. Engel, let me stop you. Do you know what</p> <p>4 computation or methods Dr. Storm actually performed</p> <p>5 in order to break down the pastureland use category 10:58AM</p> <p>6 results from his modeling and allocate that between</p> <p>7 poultry and other sources?</p> <p>8 A Well, to identify the immediate reduction in</p> <p>9 phosphorus from litter, it was a matter of turning</p> <p>10 off litter. So that again was identical to what I 10:59AM</p> <p>11 did, and as I recall in the Eucha-Spavinaw effort</p> <p>12 that he performed with the SWAT model, you know, the</p> <p>13 effort there was to turn off the soil test</p> <p>14 phosphorus as well, and so that would be identical.</p> <p>15 In the work he did for the Illinois River watershed, 10:59AM</p> <p>16 yes, it's different because he was answering a</p> <p>17 different set of questions.</p> <p>18 Q Let me hand you, Dr. Engel, what we've marked</p> <p>19 as Exhibit 16 to your deposition, which is a</p> <p>20 spreadsheet that was printed out from your 11:00AM</p> <p>21 considered materials.</p> <p>22 MR. GARREN: Two pages?</p> <p>23 Q Two pages. There were two tabs in the</p> <p>24 spreadsheet. The first tab was identified as</p> <p>25 allocation and the second tab was identified as 11:00AM</p>	<p>1 Q Have you subjected, Dr. Engel, your conceptual</p> <p>2 model for how you ought to allocate the pastureland</p> <p>3 use back to poultry litter and the actual methods</p> <p>4 and computations that are reflected in December --</p> <p>5 I'm sorry, in Exhibit 16 to peer review by the 11:02AM</p> <p>6 scientific community?</p> <p>7 MR. GARREN: Object to form.</p> <p>8 A So at this stage, you know, this specific set</p> <p>9 of calculations has not, but once again, you know,</p> <p>10 this conceptual approach is commonly employed and, 11:03AM</p> <p>11 you know, widely used, so, you know, trying to tie</p> <p>12 this down and be unique to this specific</p> <p>13 calculation, this specific calculation just reflects</p> <p>14 a general methodology that, you know, that would be</p> <p>15 employed by modelers doing comparable kinds of 11:03AM</p> <p>16 thing.</p> <p>17 Q Okay. If it's a general methodology, I ought</p> <p>18 to be able to find it in the peer-reviewed</p> <p>19 literature; correct?</p> <p>20 MR. GARREN: Object to form. 11:03AM</p> <p>21 A I mean, this level of detail may not be</p> <p>22 described in the general literature, but I think you</p> <p>23 would find a, you know, conceptual discussion of</p> <p>24 this in the general literature.</p> <p>25 MR. GEORGE: Lisa, can you go back to the</p>
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<p>1 sheet three. I believe the file name was -- hang on</p> <p>2 a moment -- allocation, underscore, 5, underscore,</p> <p>3 2.xls workbook. Do you recognize that document, Dr.</p> <p>4 Engel?</p> <p>5 A Yes. 11:01AM</p> <p>6 Q What is it?</p> <p>7 A So this seems to be where the final set of</p> <p>8 calculations were done in arriving at the values</p> <p>9 that are reported in Table 10.14 and Table 10.15 or</p> <p>10 at least a portion of those final calculations. 11:01AM</p> <p>11 Q Okay. So, Dr. Engel, the exhibit I've put in</p> <p>12 front of you, Exhibit 16, the spreadsheet, reflects</p> <p>13 the approach and the computations that support your</p> <p>14 opinions that poultry litter accounts for 45 percent</p> <p>15 or 59 percent, depending upon which time period 11:01AM</p> <p>16 you're talking about, of the phosphorus load to Lake</p> <p>17 Tenkiller; is that correct?</p> <p>18 A Correct.</p> <p>19 Q Did Dr. Storm do this, what is reflected in</p> <p>20 Exhibit 16, in arriving at his allocation to poultry 11:02AM</p> <p>21 litter?</p> <p>22 MR. GARREN: Object to form.</p> <p>23 A No. I mean, conceptually he was doing the</p> <p>24 same thing, but, you know, he didn't use this</p> <p>25 specific set of calculations in this spreadsheet. 11:02AM</p>	<p>1 prior question to which I didn't get an answer?</p> <p>2 (Whereupon, the court reporter read</p> <p>3 back the previous question at Page 350, Lines 1-6.)</p> <p>4 MR. GARREN: Same objection.</p> <p>5 A So the answer would be, no, I have not done 11:04AM</p> <p>6 that, but this conceptual approach is employed in</p> <p>7 modeling.</p> <p>8 Q Okay. Dr. Engel, there are two tabs, and</p> <p>9 hopefully I've kept them in order. Do you have the</p> <p>10 one that -- mine looks a little different than 11:04AM</p> <p>11 yours. Yeah, you've got them in the right order.</p> <p>12 The first tab that is identified in the electronic</p> <p>13 file as allocation, does this spreadsheet contain</p> <p>14 the results from your GLEAMS model?</p> <p>15 A Looks like there are probably several things 11:05AM</p> <p>16 in this. So a portion -- a portion of this would be</p> <p>17 summarized results from the GLEAMS model.</p> <p>18 Q Okay. Can you identify for me the data or</p> <p>19 numbers on the first page of Exhibit --</p> <p>20 A 16. 11:05AM</p> <p>21 Q -- 16, thank you, that come directly from the</p> <p>22 output of the GLEAMS model?</p> <p>23 A Well, so once again, the GLEAMS data that</p> <p>24 would be here are summarized GLEAMS data. So is</p> <p>25 that -- 11:05AM</p>

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1	Q And you have some values in kilograms for each	1	phosphorus, so they're not contributing new
2	year under cattle, and it happens to be the same	2	phosphorus. Again, however, you know, I would
3	value, 16,145; do you see that?	3	indicate that cattle do potentially facilitate
4	A Yes.	4	transport of some of that phosphorus that came from
5	Q What does that figure represent in terms of 11:15AM	5	poultry land waste application into riparian areas 11:19AM
6	cattle?	6	into streams, so they're helping transport and speed
7	A There was a computation in appendix -- let me	7	the loss process up, and so the portion that -- of
8	turn to the right appendix. Looks like that's going	8	that waste that one would expect to happen in the
9	to be Appendix F.	9	streams or within ten meters or so of streams is
10	Q And just so we create a Record here, Appendix 11:16AM	10	calculated, and it's Appendix F again, and that's 11:20AM
11	F to your report is entitled Contribution of Cattle	11	the value that's reported in this column on Exhibit
12	in Streams to P Loads in the Illinois River	12	16.
13	Watershed; correct?	13	Q And I don't necessarily want to debate the
14	A Correct.	14	reasonableness of your assumptions. I just want to
15	Q And you told me earlier that Bert Fisher 11:16AM	15	know what they are, Dr. Engel. Do I understand 11:20AM
16	assisted you with the preparation of Appendix F; is	16	correctly that your allocation approach, as
17	that right?	17	reflected in Exhibit 16 and carried over into your
18	A I believe he helped with Table 4 in -- am I	18	report, assumes that the only phosphorus from
19	getting this right -- Table 4 in Appendix F.	19	grazing cattle, for which grazing cattle are
20	Q Why are you pulling into your modeling work 11:16AM	20	responsible, that reaches the Illinois River or Lake 11:20AM
21	and your allocation values from Appendix F? Just	21	Tenkiller is the phosphorus deposited within ten
22	help me understand. What's the concept?	22	meters of streams as quantified in Appendix F?
23	A Sure. So the concept here was that, you know,	23	A So, yes, that's the representation and, again,
24	I do recognize that cattle are, well, recycling some	24	the rationale for that is that, you know, the cattle
25	phosphorus, are certainly also transporting some 11:17AM	25	are simply recyclers of phosphorus. They're not 11:21AM
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1	phosphorus closer to the streams and, in fact, even	1	introducing new phosphorus into the system.
2	into the streams in some instances in which they've	2	Q Now, look back at Appendix F, in particular
3	not been fenced out of those streams. So if they	3	Table 6. I don't find the 16,144 number. Do you?
4	have access to the streams, you know, they in fact	4	A I believe -- let me check my math here. I
5	do deposit some waste there that contains 11:17AM	5	believe that's a conversion from kilograms to pounds 11:22AM
6	phosphorus. So the concept here was to try to	6	or vice versa here. So it looks like that would be
7	capture that more immediate contribution from cattle	7	a conversion. In Table 6, if you look at the lower
8	through the set of calculations that's reported in	8	right-hand corner under 660 feet in total, there's a
9	Appendix F.	9	value of P in pounds per year that's represented as
10	Q Okay. Dr. Engel, is it true that the numbers 11:17AM	10	35,594, and if one converts that to kilograms, looks 11:23AM
11	that are pulled over from the in or near stream	11	like that's 16,145 as shown in Exhibit 16.
12	analysis of Appendix F for cattle are the only	12	Q Okay. So the value 16,145 is a conversion of
13	credits or contributions that you assign in your	13	the total on Table 6?
14	load allocation analysis to cattle?	14	A Yes.
15	A Let me make sure before I answer that. 11:18AM	15	Q Okay, all right. Now, in the -- I believe at 11:23AM
16	Q Sure.	16	the bottom of Exhibit 16 there is a grouping or
17	A There would be some dairy cattle contribution	17	summary of wastewater treatment plant, forest, crop,
18	that's split out here as well based on some of the	18	urban, pasture, poultry waste, poultry waste minus
19	waste that one might expect to be land applied. So	19	cattle; do you see that grouping?
20	there's a small portion from that that's looped -- 11:19AM	20	A Okay. 11:24AM
21	excuse me, grouped with some other things that would	21	Q Are the numbers beneath each of those headings
22	include swine, dairy and background.	22	percentages?
23	Q What about grazing cattle as opposed to dairy	23	A Yes. These would reflect percentages from
24	cattle, swine?	24	looks like the above computation.
25	A So, again, you know, the cattle are recycling 11:19AM	25	Q Okay. Dr. Engel, I want to focus on the last 11:24AM

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1	Q And you have some values in kilograms for each	1	phosphorus, so they're not contributing new
2	year under cattle, and it happens to be the same	2	phosphorus. Again, however, you know, I would
3	value, 16,145; do you see that?	3	indicate that cattle do potentially facilitate
4	A Yes.	4	transport of some of that phosphorus that came from
5	Q What does that figure represent in terms of 11:15AM	5	poultry land waste application into riparian areas 11:19AM
6	cattle?	6	into streams, so they're helping transport and speed
7	A There was a computation in appendix -- let me	7	the loss process up, and so the portion that -- of
8	turn to the right appendix. Looks like that's going	8	that waste that one would expect to happen in the
9	to be Appendix F.	9	streams or within ten meters or so of streams is
10	Q And just so we create a Record here, Appendix 11:16AM	10	calculated, and it's Appendix F again, and that's 11:20AM
11	F to your report is entitled Contribution of Cattle	11	the value that's reported in this column on Exhibit
12	in Streams to P Loads in the Illinois River	12	16.
13	Watershed; correct?	13	Q And I don't necessarily want to debate the
14	A Correct.	14	reasonableness of your assumptions. I just want to
15	Q And you told me earlier that Bert Fisher 11:16AM	15	know what they are, Dr. Engel. Do I understand 11:20AM
16	assisted you with the preparation of Appendix F; is	16	correctly that your allocation approach, as
17	that right?	17	reflected in Exhibit 16 and carried over into your
18	A I believe he helped with Table 4 in -- am I	18	report, assumes that the only phosphorus from
19	getting this right -- Table 4 in Appendix F.	19	grazing cattle, for which grazing cattle are
20	Q Why are you pulling into your modeling work 11:16AM	20	responsible, that reaches the Illinois River or Lake 11:20AM
21	and your allocation values from Appendix F? Just	21	Tenkiller is the phosphorus deposited within ten
22	help me understand. What's the concept?	22	meters of streams as quantified in Appendix F?
23	A Sure. So the concept here was that, you know,	23	A So, yes, that's the representation and, again,
24	I do recognize that cattle are, well, recycling some	24	the rationale for that is that, you know, the cattle
25	phosphorus, are certainly also transporting some 11:17AM	25	are simply recyclers of phosphorus. They're not 11:21AM
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1	phosphorus closer to the streams and, in fact, even	1	introducing new phosphorus into the system.
2	into the streams in some instances in which they've	2	Q Now, look back at Appendix F, in particular
3	not been fenced out of those streams. So if they	3	Table 6. I don't find the 16,144 number. Do you?
4	have access to the streams, you know, they in fact	4	A I believe -- let me check my math here. I
5	do deposit some waste there that contains 11:17AM	5	believe that's a conversion from kilograms to pounds 11:22AM
6	phosphorus. So the concept here was to try to	6	or vice versa here. So it looks like that would be
7	capture that more immediate contribution from cattle	7	a conversion. In Table 6, if you look at the lower
8	through the set of calculations that's reported in	8	right-hand corner under 660 feet in total, there's a
9	Appendix F.	9	value of P in pounds per year that's represented as
10	Q Okay. Dr. Engel, is it true that the numbers 11:17AM	10	35,594, and if one converts that to kilograms, looks 11:23AM
11	that are pulled over from the in or near stream	11	like that's 16,145 as shown in Exhibit 16.
12	analysis of Appendix F for cattle are the only	12	Q Okay. So the value 16,145 is a conversion of
13	credits or contributions that you assign in your	13	the total on Table 6?
14	load allocation analysis to cattle?	14	A Yes.
15	A Let me make sure before I answer that. 11:18AM	15	Q Okay, all right. Now, in the -- I believe at 11:23AM
16	Q Sure.	16	the bottom of Exhibit 16 there is a grouping or
17	A There would be some dairy cattle contribution	17	summary of wastewater treatment plant, forest, crop,
18	that's split out here as well based on some of the	18	urban, pasture, poultry waste, poultry waste minus
19	waste that one might expect to be land applied. So	19	cattle; do you see that grouping?
20	there's a small portion from that that's looped -- 11:19AM	20	A Okay. 11:24AM
21	excuse me, grouped with some other things that would	21	Q Are the numbers beneath each of those headings
22	include swine, dairy and background.	22	percentages?
23	Q What about grazing cattle as opposed to dairy	23	A Yes. These would reflect percentages from
24	cattle, swine?	24	looks like the above computation.
25	A So, again, you know, the cattle are recycling 11:19AM	25	Q Okay. Dr. Engel, I want to focus on the last 11:24AM

25 (Pages 356 to 359)

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<p>1 A I would agree with that, and I would also note 2 that the specific format here is a format required 3 by the GLEAMS model and, therefore, there's not a 4 readily transparent and handy way to insert that 5 type of a comment in that file. Otherwise, this 01:55PM 6 file I don't think will run or won't work when you 7 try to run this. 8 Q Well, and I understand that, and that may very 9 well be, but how, Dr. Engel, were the defendants and 10 their experts supposed to figure that out, what 01:56PM 11 input files you were actually using and associating 12 with those other sources of phosphorus? 13 A Well, if -- I guess if you traced through the 14 input files, you'll find that those are the files 15 used to represent nutrient inputs. 01:56PM 16 Q Dr. Engel, how long do you think it would take 17 you to review whatever material you need to at your 18 office to determine the answer to my question? 19 A The question again was -- 20 Q Specifically identify the input files that 01:56PM 21 were used in your various GLEAMS model scenarios to 22 represent the phosphorus contributions from dairy 23 cattle, beef cattle, swine and commercial 24 fertilizer. 25 A So that would probably -- and this is for all 01:57PM</p>	<p>1 which I think is the load allocation spreadsheet. 2 One of the other questions that was left hanging 3 that I had asked you to see if you could discover 4 the answer to on your break was with respect to the 5 second tab of the spreadsheet that has been marked 01:59PM 6 Exhibit 16, what was the source of the data 7 contained in that tab. I told you that I believed 8 it came from the routing model but you were not 9 sure. Have you been able to confirm that? 10 A I began to track that down, but due to looking 02:00PM 11 at these other issues, didn't have an opportunity to 12 pursue that to completion. So as I sit here at the 13 moment, I can't specifically tell you which files 14 this would have come out of. 15 Q And let's start general and then we'll get 02:00PM 16 more specific before we get into exactly which file. 17 Can you confirm that the loads that are reflected in 18 the second sheet of Exhibit 16 under P to lake came 19 from the output of your routing model? 20 A Without looking again at those specific files, 02:01PM 21 I didn't have a chance to firm up where this is 22 coming from. So, you know, at best it would be 23 speculation at this point without seeing the broader 24 group of files and being able to verify that. 25 Q Well, Dr. Engel, you are familiar with the 02:01PM</p>
Page 381	Page 383
<p>1 scenarios? 2 Q The actual condition scenario for 1997 to 3 2006. 4 A Probably -- 5 Q I'm sorry, and the no litter or no animal 01:57PM 6 waste and soil background 100-year scenario, those 7 two runs. 8 A So to be on the safe side, might take five or 9 six hours to make sure that I don't mislead you with 10 the response. 01:58PM 11 Q Okay, and, Dr. Engel, you are aware that you 12 and I have had a history in this case of 13 communicating back and forth between counsel via 14 E-mail for information as to the location of certain 15 files? 01:58PM 16 A Correct. 17 Q Okay. Do you have any objection to providing 18 me with that information through Mr. Garren in an 19 E-mail? 20 A Assuming that Mr. Garren is okay with that, 01:58PM 21 that would be fine with me. 22 Q Okay. 23 MR. GEORGE: I'm going to make that 24 request, Rick. 25 Q Okay. Let's go back to Exhibit 16, Dr. Engel, 01:58PM</p>	<p>1 approach and the method that you used to allocate 2 back sources of phosphorus to, among other things, 3 poultry litter as reflected in Exhibit 16, are you 4 not? 5 A I am. 02:01PM 6 Q That's your work; right? 7 A Correct. 8 Q Surely you know the source that was intended 9 for the basic information that was used in -- as a 10 starting point for that computation, do you not? 02:01PM 11 A It's been a number of months since this 12 computation was done, and there are thousands of 13 files, if not tens of thousands of files. So, you 14 know, this is -- I did not review which file flowed 15 into this one in preparing for the deposition, and 02:02PM 16 during lunch didn't have a chance to backtrack as to 17 where this specifically came from. So I don't want 18 to speculate for you as to, you know, the exact 19 source as to which this came from right now. 20 MR. GEORGE: Let me get somebody on the 02:02PM 21 phone. 22 (Whereupon, a discussion was held off 23 the Record.) 24 Q All right. So, Dr. Engel, to summarize where 25 we are, and you tell me if you disagree, as we sit 02:03PM</p>

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1 here today, you cannot advise the defendants or  
 2 their experts as to the source of the information  
 3 that you used in terms of phosphorus to lake, which  
 4 was an integral part of your allocation of  
 5 phosphorus to poultry litter as reflected in Exhibit 02:04PM  
 6 16?

7 A Well, Exhibit 16 contains values. I need to  
 8 identify the source of that -- of those values by  
 9 looking through additional files before I'm going to  
 10 be confident in telling you where they came from. 02:04PM

11 Q So is the answer to my question that's  
 12 correct? Do you recall my question?

13 A Could you repeat your question?

14 MR. GEORGE: Lisa, could you read it back,  
 15 please? 02:04PM

16 (Whereupon, the court reporter read  
 17 back the previous question at Page 383, Line 24 to  
 18 Page 384, Line 6.)

19 A Correct, with the explanation I provided  
 20 prior. 02:05PM

21 Q Dr. Engel, on this same page of Exhibit 16,  
 22 Tab 2, there are some land use categories again; we  
 23 see crop urban and forest?

24 A Correct.

25 Q Okay, and there are a series of numbers I 02:05PM

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1 think that are intended to be kilograms of  
 2 phosphorus associated with each of those land uses;  
 3 correct?

4 A Without studying this further, I'm not sure  
 5 what the units are here. 02:05PM

6 Q Okay, but there are a series of numbers in  
 7 terms of phosphorus load associated with each of  
 8 those three land use categories; is that right?

9 A There are, but for whatever reason, they seem  
 10 to be averaged here across time. 02:06PM

11 Q Okay. Where do those numbers come from?

12 A Again, without spending some time with this  
 13 spreadsheet and other materials, I would hate to  
 14 speculate as we sit here.

15 Q Dr. Engel, can you at least confirm that the 02:06PM  
 16 numbers in this tab on Exhibit 16 beneath the land  
 17 use categories, crop, urban and forest, are the  
 18 output or some output of the GLEAMS model?

19 A They would be.

20 Q Okay. Can you tell either from your memory or 02:06PM  
 21 from looking at Exhibit 16 which GLEAMS run or  
 22 scenario was used to derive the numbers that are  
 23 reflected?

24 A I can't recall that but, again, I'm going to  
 25 have to look at the spreadsheet and related 02:07PM

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1 materials in more detail to understand that again.

2 Q Okay. Dr. Engel, same question as before.

3 Once you get back to your office and you have  
 4 available to you all of your file materials,

5 including electronic files, how long do you believe 02:07PM

6 it would take you to answer the question as to the  
 7 source of the numbers in the column P to lake and  
 8 the source of the numbers in the columns, crop,  
 9 urban and forest?

10 A Once I can make time, probably three or four 02:07PM  
 11 hours.

12 Q Same question as before, Dr. Engel. Would you  
 13 have any objection to providing that information to  
 14 your counsel, Mr. Garren, so that he can provide it  
 15 to me? 02:08PM

16 A If Mr. Garren is okay with that, that will be  
 17 okay.

18 MR. GEORGE: Rick, are you okay with that?

19 MR. GARREN: So noted.

20 MR. GEORGE: Does that mean yes? 02:08PM

21 MR. GARREN: Doesn't mean anything.

22 MR. GEORGE: So you're not willing to  
 23 say --

24 MR. GARREN: I'm not saying anything right  
 25 now, but I'm sure given what he can provide to us, 02:08PM

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1 if you all still can't figure it out, we want to  
 2 help where we can I'm sure.

3 MR. GEORGE: I'm not sure what to make of  
 4 that. I guess we'll see what the future holds.

5 Q Dr. Engel, can you go to the other page of 02:09PM  
 6 Exhibit 16, which is the allocation page, Tab 1.

7 A Okay.

8 Q Can you see the -- can you explain, Dr. Engel,  
 9 how in this allocation process you backed out the  
 10 portions of the phosphorus load from pastures that 02:09PM  
 11 you were attributing to swine, dairy and background  
 12 soil conditions?

13 A Is commercial fertilizer in that group as  
 14 well?

15 Q I'm sorry? 02:10PM

16 A Was commercial fertilizer in that group as  
 17 well?

18 Q I don't know, but let me amend my question.

19 Can you explain how you backed out those sources,  
 20 plus commercial fertilizer? 02:10PM

21 A So these would have been from a -- so at a  
 22 higher level without going into specific files, this  
 23 would have been a run in which poultry waste would  
 24 have been off. Soil test phosphorus would have been  
 25 set to background levels. 02:10PM

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<p style="text-align: right;">Page 388</p> <p>1 Q Well, I understand that, but how did you get</p> <p>2 specific values from that analysis for the portion</p> <p>3 of the phosphorus load that you were attributing to</p> <p>4 swine, dairy cattle and background soil?</p> <p>5 A So if -- so from that model run that I was 02:11PM</p> <p>6 describing, if you remove forest, crop, urban, the</p> <p>7 remainder would have been attributable to pasture.</p> <p>8 I guess wastewater treatment would need to be</p> <p>9 excluded here as well, and a portion -- whatever the</p> <p>10 portion calculated here and represented in Exhibit 02:11PM</p> <p>11 16 that was attributed to cattle as we talked about</p> <p>12 earlier today, that was taken out of the pasture as</p> <p>13 well. So the portion that remained in pasture then</p> <p>14 would be attributable to background, swine, dairy.</p> <p>15 Q And poultry? 02:12PM</p> <p>16 A Remember, poultry was turned off in this.</p> <p>17 Q So is that methodology that you have just</p> <p>18 described what led to the -- if you look at Page 93</p> <p>19 of your report -- the 11 percent values for swine,</p> <p>20 dairy and background that you report in Table 10.15? 02:12PM</p> <p>21 A Correct.</p> <p>22 Q Okay. Where is commercial fertilizer in your</p> <p>23 table?</p> <p>24 A I believe commercial fertilizer would be in</p> <p>25 the crop mix or in the category labeled crop over 02:13PM</p>	<p style="text-align: right;">Page 390</p> <p>1 sources do you believe are included in that pasture</p> <p>2 load?</p> <p>3 A Excuse me. Without an opportunity to, you</p> <p>4 know, see the equations and calculations behind this</p> <p>5 and the other supporting files, it's a real 02:16PM</p> <p>6 challenge to sit here and even speculate without</p> <p>7 being very speculative at this stage.</p> <p>8 Q Isn't it true, Dr. Engel, that to arrive at</p> <p>9 that pasture load, that you started with the total</p> <p>10 amount of phosphorus that is received at the outlet 02:16PM</p> <p>11 stations in the watershed directly above Lake</p> <p>12 Tenkiller and you subtracted GLEAMS edge of field</p> <p>13 phosphorus loads and assumed that the balance comes</p> <p>14 from pasture?</p> <p>15 A I'm not certain as I look at this at the 02:17PM</p> <p>16 moment without an opportunity to look behind this</p> <p>17 more and look at supporting files, so --</p> <p>18 Q Does it make sense, Dr. Engel, and do you</p> <p>19 believe it is valid for purposes of allocating</p> <p>20 phosphorus load to sources to be subtracting GLEAMS 02:17PM</p> <p>21 edge of field output loads from routing model loads</p> <p>22 to Lake Tenkiller given that they're two different</p> <p>23 models?</p> <p>24 MR. GARREN: Object to form.</p> <p>25 A There could be instances where that would 02:18PM</p>
<p style="text-align: right;">Page 389</p> <p>1 here then.</p> <p>2 Q Did you actually apply commercial fertilizer</p> <p>3 to cropland?</p> <p>4 A I believe so. Again, without looking through</p> <p>5 those input files and confirming for you, I wouldn't 02:13PM</p> <p>6 want to speculate as we sit here.</p> <p>7 Q Go back to Exhibit 16. The second tab, it has</p> <p>8 at the top of it this P to lake reference. Do you</p> <p>9 see towards the bottom portion of the exhibit there</p> <p>10 is a column referenced pasture -- actually it's a 02:14PM</p> <p>11 row that says pasture pounds and then out to the</p> <p>12 right of it has the figure 260,983?</p> <p>13 A I see that.</p> <p>14 Q Okay. What sources does this pasture load</p> <p>15 include? 02:14PM</p> <p>16 A Without, again, being able to look at a</p> <p>17 broader group of files, as I'm sitting here at the</p> <p>18 moment, I could only speculate. I think I know what</p> <p>19 it is but, again, I wouldn't want to speculate</p> <p>20 without an opportunity to consult that broader group 02:14PM</p> <p>21 of files.</p> <p>22 Q Tell me what you think it is, and if you</p> <p>23 decide after looking at something that your memory</p> <p>24 wasn't exactly right, you can notify me of that</p> <p>25 later. Where do you think it came from and what 02:15PM</p>	<p style="text-align: right;">Page 391</p> <p>1 certainly be valid.</p> <p>2 Q Would it be valid here?</p> <p>3 A Again, without an opportunity to look at what</p> <p>4 is going on here --</p> <p>5 Q Dr. Engel, I'm not asking you at this point 02:18PM</p> <p>6 what you did. I want to know if what I just</p> <p>7 described would be valid.</p> <p>8 A Could you describe again what you -- sorry.</p> <p>9 MR. GEORGE: Lisa, can you read it back?</p> <p>10 (Whereupon, the court reporter read 02:19PM</p> <p>11 back the previous question at Page 390, Lines</p> <p>12 18-23.)</p> <p>13 A And, again, my answer would be that, yeah, it</p> <p>14 could be. You know, I would need to understand the</p> <p>15 context further and see if that were reasonable. 02:19PM</p> <p>16 Q All right. Let's go back to Appendix F for a</p> <p>17 moment. Do you recall that we did establish that</p> <p>18 one of the -- I'm sorry, that central to the way in</p> <p>19 which you backed out the cattle contribution from</p> <p>20 your allocation was the analysis completed in 02:20PM</p> <p>21 Appendix F; right?</p> <p>22 A Yes.</p> <p>23 Q Okay, and in particular, you scaled back, if</p> <p>24 you will, the pasture load and allocated it to</p> <p>25 cattle based upon this 35,594 pound number reflected 02:20PM</p>

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<p>1 in Table 6; right?</p> <p>2 A Correct.</p> <p>3 Q Okay. Now, does that figure, Dr. Engel, the</p> <p>4 35,594 pounds, reflect the full amount of cattle</p> <p>5 manure that is, or I'm sorry, phosphorus from cattle 02:20PM</p> <p>6 manure that is deposited onto the land surface in</p> <p>7 the watershed?</p> <p>8 A No, it would not.</p> <p>9 Q Okay. It's a small subset of what cattle</p> <p>10 actually defecate; do you agree? 02:20PM</p> <p>11 A It's a subset, yes.</p> <p>12 Q Okay, and it's a small subset; right?</p> <p>13 A Without looking at that -- that computation</p> <p>14 may be in here someplace as well.</p> <p>15 Q Okay. Now, in Appendix F you describe what is 02:21PM</p> <p>16 called a capture zone analysis. Do you recall that</p> <p>17 terminology?</p> <p>18 A Correct.</p> <p>19 Q For the Record, what is a capture zone</p> <p>20 analysis? 02:21PM</p> <p>21 A Make sure I've got the context correct. So</p> <p>22 are we on --</p> <p>23 Q At two.</p> <p>24 A At two. Well, the purpose of the analysis, if</p> <p>25 we can start there, was to identify potential 02:21PM</p>	<p>1 that you used in your allocation, the cattle, based</p> <p>2 on your analysis, had to be defecating within 10</p> <p>3 meters of the stream; is that right?</p> <p>4 A Or in the stream.</p> <p>5 Q Or in the stream? 02:23PM</p> <p>6 A Yes.</p> <p>7 Q Okay. Now, so in order to do that, you had to</p> <p>8 identify the number of pastures in the watershed</p> <p>9 that had access for cattle to streams; right?</p> <p>10 A Right. 02:24PM</p> <p>11 Q And you didn't actually physically identify</p> <p>12 them; you made some assumptions; right?</p> <p>13 A Assumptions that a calculation was made in</p> <p>14 doing that, yes.</p> <p>15 Q Okay, and that -- those assumptions and that 02:24PM</p> <p>16 calculation led to a number as to the total acreage</p> <p>17 or the total number of cattle on pastures that had</p> <p>18 access to streams in the basin; correct?</p> <p>19 A Correct.</p> <p>20 Q Okay. Now, in arriving at this 35,594 pound 02:24PM</p> <p>21 per year of phosphorus figure that is represented as</p> <p>22 the amount of phosphorus deposited by cattle within</p> <p>23 10 miles of streams, did you use all of the pastures</p> <p>24 that you had identified as having access to streams?</p> <p>25 MR. ELROD: You said miles. 02:24PM</p>
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<p>1 pastures and, therefore, cattle that would be in</p> <p>2 those pastures that would potentially have access to</p> <p>3 streams or I guess third order and higher streams in</p> <p>4 the IRW.</p> <p>5 Q Okay, and did you place some limitations on 02:22PM</p> <p>6 how close the cow had to be to the stream in terms</p> <p>7 of defecating in arriving at your 35,594 pound per</p> <p>8 year figure in Table 6?</p> <p>9 A I guess there are two -- as I recall, there</p> <p>10 are two numbers here in the works. So are we still 02:22PM</p> <p>11 talking about the capture zone analysis and the</p> <p>12 materials on F-2 or are we talking about Table 6?</p> <p>13 Q I'm back to F-3, Table 6.</p> <p>14 A Table 6, okay.</p> <p>15 Q And, here, let me help you or at least help 02:23PM</p> <p>16 you understand the question. In the paragraph above</p> <p>17 Table 6, do you see that paragraph that starts with</p> <p>18 using?</p> <p>19 A Yes.</p> <p>20 Q In the first sentence, and it's a long one, 02:23PM</p> <p>21 you say that you have computed the annual P</p> <p>22 deposited in or within 10 meters of streams, and</p> <p>23 that is shown in Table 6; right?</p> <p>24 A Yes.</p> <p>25 Q Okay. So in order to make it into the number 02:23PM</p>	<p>1 Q I'm sorry, 10 meters.</p> <p>2 A Okay. So the capture zone analysis calculated</p> <p>3 the expected number of cattle that would likely have</p> <p>4 access to streams. Realize, too, that not all</p> <p>5 cattle within those areas would have access to 02:25PM</p> <p>6 streams. A fairly significant percentage would be</p> <p>7 fenced out, and the percentage that was based --</p> <p>8 that was fenced out was 45 percent based on a</p> <p>9 conversation with Mr. Ed Fite regarding his</p> <p>10 experiences in the watershed and opportunities to 02:25PM</p> <p>11 observe how many pastures along this type of stream</p> <p>12 would typically have fence.</p> <p>13 Q Okay. So that gets to my question, Dr. Engel.</p> <p>14 The number that is reflected in Table 6, 35,594</p> <p>15 pounds of phosphorus per year, and that you used in 02:26PM</p> <p>16 allocating a portion of the pasture load to cattle,</p> <p>17 has been reduced by 45 percent based upon a</p> <p>18 conversation that you had with Ed Fite; is that</p> <p>19 right?</p> <p>20 A So, yes, it would be reduced by 45 percent. 02:26PM</p> <p>21 Q Okay. Now, tell me when you had this</p> <p>22 conversation with Ed Fite about the percentage of</p> <p>23 pastures in the watershed on which cattle had been</p> <p>24 fenced out.</p> <p>25 A When? 02:26PM</p>

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<p>1 Q When.</p> <p>2 A This would have been -- well, certainly prior</p> <p>3 to May of 2008.</p> <p>4 Q For fence but I had to figure that out.</p> <p>5 A My recollection, though, is that it was 02:27PM</p> <p>6 probably in March or April of 2008.</p> <p>7 Q Where were you when you had this conversation</p> <p>8 with Mr. Fite?</p> <p>9 A I believe I was on my cell phone, and Bert</p> <p>10 Fisher was part of that conversation as well. 02:27PM</p> <p>11 Q Well, were you in Oklahoma or northwest</p> <p>12 Arkansas on your cell phone?</p> <p>13 A No. My recollection was that I was someplace</p> <p>14 in Indiana. I don't know exactly where.</p> <p>15 Q Okay, and where was Mr. Fite when you were 02:27PM</p> <p>16 talking to him on the phone?</p> <p>17 A I don't recall.</p> <p>18 Q Okay. Did he call you and you just happened</p> <p>19 into this conversation or did you make a specific</p> <p>20 call to Mr. Fite to secure this information? 02:28PM</p> <p>21 A A specific call was made because there was a</p> <p>22 need to understand how many cattle, due to fencing,</p> <p>23 would not have access to streams.</p> <p>24 Q Okay, and who determined that Mr. Fite would</p> <p>25 be the person with the best knowledge on that 02:28PM</p>	<p>1 funded or has been involved in implementation of</p> <p>2 best management practices, including fences, and so</p> <p>3 Mr. Fite would be knowledgeable of fencing of cattle</p> <p>4 out of streams in this area.</p> <p>5 Q Okay. Did Mr. Fite provide you with any study 02:29PM</p> <p>6 or data or evidence to support the claim that you</p> <p>7 make on Page F-3 that 40 to 50 percent of pastures</p> <p>8 that touch streams in the Illinois River watershed</p> <p>9 fence cattle from the stream or river?</p> <p>10 A If there were a specific study, we could have 02:30PM</p> <p>11 used it and cited it. So I don't believe there was</p> <p>12 a specific study that would be representative of the</p> <p>13 IRW. Again, and I think this was based on his</p> <p>14 personal experience, there may have been some</p> <p>15 studies on some smaller areas from what I recall. 02:30PM</p> <p>16 So whether those were considered in his estimate, I</p> <p>17 don't recall as we sit here.</p> <p>18 Q Okay. Tell me and tell the court exactly what</p> <p>19 Mr. Fite told you about the percentage of cattle</p> <p>20 that are fenced from the stream or river in the 02:31PM</p> <p>21 Illinois River watershed.</p> <p>22 A So, again, we're talking about third order</p> <p>23 streams and larger streams, and his estimate of the</p> <p>24 amount of the pastures that would have access to</p> <p>25 these types of streams or rivers, his indication was 02:31PM</p>
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<p>1 subject?</p> <p>2 MR. GARREN: Object to form.</p> <p>3 A I believe that was a result of a conversation</p> <p>4 with Bert Fisher.</p> <p>5 Q Okay. How many times prior to this phone call 02:28PM</p> <p>6 had you had opportunity to talk with or work with</p> <p>7 Mr. Fite?</p> <p>8 A I had not worked with him prior to this.</p> <p>9 Q Had you ever talked to him prior to this?</p> <p>10 A Not to my knowledge. 02:28PM</p> <p>11 Q Okay. Do you know who Ed Fite is?</p> <p>12 A As I recall, he's been involved with the OCC.</p> <p>13 Q Which is the Oklahoma Conservation Commission?</p> <p>14 A Conservation Commission I believe. So I don't</p> <p>15 recall if he's director or executive director. All 02:29PM</p> <p>16 I know is he's had an affiliation with that</p> <p>17 organization.</p> <p>18 Q Okay. What's Mr. Fite's educational</p> <p>19 background?</p> <p>20 A I'm not sure. 02:29PM</p> <p>21 Q Okay. Is Mr. Fite a cattle rancher?</p> <p>22 A My recollection is that he does have some</p> <p>23 cattle or at least certainly has experiences in the</p> <p>24 watershed with cattle and observation or</p> <p>25 opportunities to observe cattle, and the OCC has 02:29PM</p>	<p>1 that 40 to 50 percent of those pastures would have</p> <p>2 fence that would preclude the cattle from walking</p> <p>3 into the riparian area or walking into those</p> <p>4 streams.</p> <p>5 Q Did he use those figures, 40 to 50 percent? 02:31PM</p> <p>6 A 40 to 50 percent was his number, and that's</p> <p>7 what I reported here in F-3.</p> <p>8 Q Okay, and did Mr. Fite limit his answer to</p> <p>9 third order and higher streams?</p> <p>10 A I believe that the -- you know, that the 02:32PM</p> <p>11 discussion or he was -- Bert described what third</p> <p>12 order streams would tend to look like and how those</p> <p>13 would be represented on maps, and it was based on,</p> <p>14 you know, Mr. Fite's interpretation of those as to</p> <p>15 the amount of fence. 02:32PM</p> <p>16 Q Did you explain to Mr. Fite that you wanted to</p> <p>17 use information obtained from him to support a</p> <p>18 scientific opinion to allocate fault to defendants</p> <p>19 in a lawsuit?</p> <p>20 A I think we told him about the analysis we were 02:32PM</p> <p>21 trying to conduct. Whether it was conveyed to</p> <p>22 him -- I believe it was conveyed to him that this</p> <p>23 was going to be part of an analysis that was going</p> <p>24 into an expert report.</p> <p>25 Q Are you confident of that, that you told Mr. 02:33PM</p>

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<p>1 Fite that the information he was providing was going 2 to be used in analysis in a report that you were 3 going to submit to the court? 4 A That's my recollection. 5 Q Okay. 02:33PM 6 MR. GEORGE: Let's take a break and change 7 tape. 8 VIDEOGRAPHER: We are now off the Record. 9 The time is 2:33 p.m. 10 (Following a short recess at 2:33 p.m., 02:33PM 11 proceedings continued on the Record at 2:41 p.m.) 12 VIDEOGRAPHER: We are back on the Record. 13 The time is 2:41 p.m. 14 Q Dr. Engel, do cattle that are grazing in the 15 Illinois River watershed defecate within 10 meters 02:41PM 16 of first and second order streams? 17 A Yes, some do. 18 Q Okay. Why did you exclude pastures that have 19 access to first and second order streams from your 20 cattle analysis in Appendix F that form the basis 02:41PM 21 for your allocation of phosphorus loads to cattle? 22 MR. GARREN: Object to form. 23 A I'm just making sure that I'm correct that 24 this was third order, if you don't mind for just a 25 moment. 02:42PM</p>	<p>1 streams. 2 Q If a cow has been grazing in or near a first 3 or second order stream and has left behind what you 4 leave behind when you graze, which is cattle manure, 5 what happens to the phosphorus from that cattle 02:44PM 6 manure when that rainfall events occurs and that 7 first and second order stream fills up with water? 8 MR. GARREN: Object to form. 9 A So it would certainly be an opportunity for 10 some of that phosphorus that was in that cattle 02:44PM 11 waste to move during that scenario that you've 12 described. 13 Q Okay. Dr. Engel, who is Indrajeet Chaubey? 14 A He's a professor that is within my program at 15 Purdue, a colleague of mine. 02:45PM 16 Q Is he within the same department as you? 17 A Correct. 18 Q And what is that department? 19 A Agricultural and biological engineering. 20 Q Does Dr. -- am I saying his name correctly, 02:45PM 21 Chaubey? 22 A Chaubey, yeah. 23 Q Does Dr. Chaubey report to you? 24 A Yes. 25 Q Have you talked with Dr. Chaubey about your 02:45PM</p>
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<p>1 Q Sure. 2 A So third order or larger. Typically those 3 smaller streams are not flowing for a significant 4 portion of the year and, therefore, the decision in 5 the analysis was to exclude those because presumably 02:42PM 6 one of the reasons the cattle are coming down and 7 spending time within 10 meters or within these 8 streams is for water, and because the smaller 9 streams would tend only to have flow during a much 10 more restricted part of the time, they were excluded 02:43PM 11 from the analysis, and in retrospect, having seen 12 some more recent literature, you know, the time the 13 cattle spend in and near streams is probably 14 overestimated in the analysis represented in F-2, so 15 I'm comfortable with the analysis. 02:43PM 16 Q Dr. Engel, these first and second order 17 streams in which cattle might actually be grazing in 18 the stream when there's not water there, are they 19 full of water when you get heavy rains in the 20 watershed? 02:43PM 21 A Well, during a significant runoff event, yes, 22 those smaller streams would have water in them, but 23 I think characterizing those smaller streams as 24 streams that cattle are going to be grazing in is 25 probably a mischaracterization of those smaller 02:44PM</p>	<p>1 work in this case? 2 A Only in very limited conversations. 3 Q What conversations have you had with him in 4 terms of subject matter about this case? 5 A So the subject matter would tend to be 02:45PM 6 probably far ranging, you know, certainly 7 discussions about his experiences in this watershed 8 or areas adjacent to this watershed. You know, I'm 9 certainly, you know, aware that, you know, he has a 10 lot of those kind of experiences and, you know, 02:46PM 11 significant expertise, you know, in this landscape 12 in not only modeling, hydrologic water quality 13 modeling, but also in data collection within the 14 field and analyses of those data. So the 15 conversations would have been regarding some of 02:46PM 16 those subjects typically. 17 Q Have you asked Dr. Chaubey to perform any work 18 in connection with this lawsuit or the Illinois 19 River watershed? 20 A No, I have not. 02:46PM 21 Q Is it true, Dr. Engel, that you have asked Dr. 22 Chaubey to meet with the lawyers representing the 23 State of Oklahoma in this case? 24 A I think that the request was from the lawyers 25 to meet with him, and it wasn't a specific request 02:47PM</p>

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<p>1 Q The total predicted loads of phosphorus at the</p> <p>2 three outlet stations.</p> <p>3 A I believe those -- the predicted -- I believe</p> <p>4 the predicted may have changed again. I would need</p> <p>5 to look. 03:00PM</p> <p>6 Q It's Exhibit 4 if you want to take a look.</p> <p>7 Your errata is Exhibit 4.</p> <p>8 A So certainly there was some things that</p> <p>9 changed in the errata as represented by Exhibit 4.</p> <p>10 I'm just trying to think. 03:01PM</p> <p>11 Q Let me back up for a second and maybe I can</p> <p>12 help. Isn't it true, Dr. Engel, that the purpose or</p> <p>13 at least one of the main purposes of the September</p> <p>14 4th errata is that you had rerun your routing model</p> <p>15 and you had new predicted loads? 03:02PM</p> <p>16 A So, yes, the routing model was rerun, and how</p> <p>17 that interacts with Exhibit 16, at the moment</p> <p>18 without stepping back and stepping through this but</p> <p>19 generally --</p> <p>20 Q Can I take another run at it? 03:03PM</p> <p>21 A Sure.</p> <p>22 Q Dr. Engel, if the output of the routing model</p> <p>23 is part of the information that's used in the waste</p> <p>24 load allocation in Exhibit 16 and the routing model</p> <p>25 output changes after you developed Exhibit 16, then 03:03PM</p>	<p>1 terms of context, it seems to me that you are</p> <p>2 evaluating, using some runoff coefficients, the</p> <p>3 potential phosphorus load based upon the amount of</p> <p>4 poultry litter applied in the watershed; is that</p> <p>5 fair? 03:05PM</p> <p>6 A That's a fair characterization.</p> <p>7 Q And the bolded opinion that appears on Page</p> <p>8 37, you state that based upon that analysis, between</p> <p>9 432 pounds to nearly 500,000 pounds annually of</p> <p>10 phosphorus from poultry litter application is lost 03:06PM</p> <p>11 to water; do you see that? I did a horrible job.</p> <p>12 Can you read your bolded opinion?</p> <p>13 A Sure. I'll try to get the hundred thousand</p> <p>14 piece slid back in there.</p> <p>15 Q Go ahead. 03:06PM</p> <p>16 A So average annual P loads to water in the</p> <p>17 Illinois River watershed attributable to poultry</p> <p>18 waste application to pastures is calculated between</p> <p>19 432,000 pounds to nearly 500,000 pounds annually</p> <p>20 based on poultry waste P application to the 03:06PM</p> <p>21 landscape in literature, P loss coefficients.</p> <p>22 Q What do you mean by the average annual P loads</p> <p>23 to water in that opinion; what type of water are you</p> <p>24 talking about?</p> <p>25 A So these would be loads to the streams and 03:06PM</p>
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<p>1 you ought to have a subsequent P load allocation</p> <p>2 spreadsheet based upon the results of the new</p> <p>3 phosphorus routing model; correct?</p> <p>4 A That's what I'm trying to understand here is,</p> <p>5 yeah, if that routing data that you speak of went 03:03PM</p> <p>6 into Exhibit 16 or not here at the moment.</p> <p>7 Q In light of the uncertainty around this and</p> <p>8 the recognition that there has been a new phosphorus</p> <p>9 routing model run, Dr. Engel, can you tell us today</p> <p>10 whether or not Opinion No. 8 on Page No. 2 where you 03:04PM</p> <p>11 state that 45 percent or 59 percent, depending upon</p> <p>12 the time frame, of the phosphorus reaching Lake</p> <p>13 Tenkiller comes from poultry litter is still a valid</p> <p>14 number in light of the new results from the</p> <p>15 phosphorus routing model? 03:04PM</p> <p>16 A I guess I would probably want to recheck this</p> <p>17 at this stage given some of the questions you've</p> <p>18 raised about Exhibit 16, but would just indicate</p> <p>19 again that, you know, the waste allocation here in</p> <p>20 Opinion 8 is consistent with the findings of others 03:04PM</p> <p>21 in this watershed.</p> <p>22 Q Okay. Let's switch topics and go to Page 37</p> <p>23 of your report, Dr. Engel.</p> <p>24 A Okay.</p> <p>25 Q Page 37 and for a few pages thereafter in 03:05PM</p>	<p>1 rivers within the IRW that one would potentially</p> <p>2 expect to reach the gauging stations.</p> <p>3 Q All right. A couple of things and let's pull</p> <p>4 it apart. Dr. Engel, you're not contending, are</p> <p>5 you, that based upon this runoff coefficient 03:07PM</p> <p>6 analysis, that 432,000 to 500,000 pounds of</p> <p>7 phosphorus per year from poultry litter makes it to</p> <p>8 Lake Tenkiller?</p> <p>9 A Well, so, no, it does not, because based on</p> <p>10 the last ten years, the average load of phosphorus 03:07PM</p> <p>11 to Lake Tenkiller is a little bit more than 500,000</p> <p>12 pounds per year. So these numbers are based on</p> <p>13 coefficients in the literature, coefficients that</p> <p>14 have been used actually in this watershed by several</p> <p>15 authors, and one, in fact, arrived in this watershed 03:08PM</p> <p>16 up to I guess the gauging station at Bridge 59 near</p> <p>17 the border.</p> <p>18 Q Isn't it true, Dr. Engel, that the studies</p> <p>19 that you're referring to are edge of field runoff</p> <p>20 studies? 03:08PM</p> <p>21 A No, not all of them are.</p> <p>22 Q Okay. For example, the work of Dr. Sharpley</p> <p>23 that you referred to, is that an edge of field</p> <p>24 runoff study?</p> <p>25 A That's actually I believe from a group of 03:08PM</p>

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<p>1 off and, again, you know, as you indicated, with the</p> <p>2 dialogue with Mr. George, you know, a calculation of</p> <p>3 this value specific to the IRW turns out to be about</p> <p>4 2.8 percent.</p> <p>5 Q All right, and your text about -- regarding 04:11PM</p> <p>6 this figure that's on Page 37, you say Sharpley, et</p> <p>7 al, 2007, indicates 5 percent of poultry waste</p> <p>8 applied to the land is lost in surface runoff. See</p> <p>9 Figure 8.1; correct? That's on your prior page.</p> <p>10 A Oh, sorry. 04:12PM</p> <p>11 Q Second paragraph. Do you see the reference?</p> <p>12 A Ah, yes, okay, yes.</p> <p>13 Q First, you're not really saying 5 percent of</p> <p>14 poultry waste; you mean 5 percent of phosphorus in</p> <p>15 poultry waste; is that more precise? 04:12PM</p> <p>16 A My intention, yes, was to indicate phosphorus.</p> <p>17 I would have to look back to that original paper to</p> <p>18 see how that was stated.</p> <p>19 Q Well, Figure 8.1 just refers to phosphorus;</p> <p>20 correct? 04:12PM</p> <p>21 A It seems to be -- yes, it says P runoff,</p> <p>22 although I've seen other papers that indicate that</p> <p>23 in fact --</p> <p>24 Q I'm just asking about the Sharpley reference,</p> <p>25 sir. 04:13PM</p>	<p>1 along with the wastewater treatment plant inputs to</p> <p>2 edge of field or to streams, ultimately reaches the</p> <p>3 three gauging stations near Lake Tenkiller. So, in</p> <p>4 fact, GLEAMS has been calibrated to reproduce values</p> <p>5 that match observed values at those staging 04:14PM</p> <p>6 stations.</p> <p>7 Q All right. Well, I understand there's two</p> <p>8 steps or two components to get to a gauging station.</p> <p>9 I'm just asking you about the GLEAMS operations on a</p> <p>10 field scale. It computes an output for an edge of 04:15PM</p> <p>11 field value for each field?</p> <p>12 A Correct.</p> <p>13 Q Okay, and GLEAMS doesn't know the difference</p> <p>14 between a field that is right beside the Illinois</p> <p>15 River water and one that is half a mile from the 04:15PM</p> <p>16 Illinois River?</p> <p>17 A It would in some sense, and let me tell you</p> <p>18 how. So GLEAMS is -- I guess maybe it does not.</p> <p>19 I'm sorry.</p> <p>20 Q Okay. All right. Let me jump to the issue of 04:15PM</p> <p>21 source selection, and when I say source selection,</p> <p>22 that means the sources that you, the modeler,</p> <p>23 elected to use as inputs into your modeling.</p> <p>24 A Okay.</p> <p>25 Q And you discussed this with Mr. George, so I 04:16PM</p>
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<p>1 A Okay. So the Sharpley reference, based on the</p> <p>2 figure, seems to indicate P runoff.</p> <p>3 Q All right. Now, where is this -- this is</p> <p>4 runoff to the edge of a field. That's what I wanted</p> <p>5 to get clear in my mind. Is that what this is 04:13PM</p> <p>6 intended to convey to the reader?</p> <p>7 A Based on this figure, yes, it appears to be</p> <p>8 edge of field.</p> <p>9 Q All right. In your model in GLEAMS, GLEAMS</p> <p>10 runs its processes on a field scale level; right? 04:13PM</p> <p>11 A Correct.</p> <p>12 Q And computes an output of phosphorus for each</p> <p>13 of the fields as it operates on the field; correct?</p> <p>14 A Yes.</p> <p>15 Q Okay, and for each of the fields that GLEAMS 04:13PM</p> <p>16 generates a field-specific output, that is an edge</p> <p>17 of field number; correct?</p> <p>18 A Yes.</p> <p>19 Q All right. Then your overall process of</p> <p>20 collecting this together, you sum up all of the edge 04:14PM</p> <p>21 of field outputs and that is the GLEAMS output?</p> <p>22 MR. GARREN: Object to form.</p> <p>23 A Yes, that's correct. Let me add just a little</p> <p>24 bit of clarification to that. So GLEAMS has been</p> <p>25 calibrated in my process so that the GLEAMS inputs, 04:14PM</p>	<p>1 don't want to recover that ground, but let me ask</p> <p>2 you to look at your report, Appendix D, Page 41.</p> <p>3 A Okay.</p> <p>4 Q In the very first paragraph you say, a</p> <p>5 phosphorus mass balance for the Illinois River 04:16PM</p> <p>6 watershed will be completed to identify the</p> <p>7 important P sources to be considered in modeling.</p> <p>8 Point and non-point sources of P of significance,</p> <p>9 parenthesis, greater than 2 percent of P based on</p> <p>10 mass balance, closed parenthesis, will be 04:16PM</p> <p>11 considered. Did I read your text correctly?</p> <p>12 A Yes.</p> <p>13 Q Is it a correct interpretation, Dr. Engel,</p> <p>14 that the sources that you selected to model were</p> <p>15 those that were greater than 2 percent as reported 04:17PM</p> <p>16 by the mass balance study?</p> <p>17 A I guess I better double check that to make</p> <p>18 sure. So it looks to me like those bigger than 2</p> <p>19 percent were considered.</p> <p>20 Q All right. Now, is there any written criteria 04:17PM</p> <p>21 for which potential sources of phosphorus in the</p> <p>22 Illinois River watershed would be included in the</p> <p>23 mass balance study?</p> <p>24 A So I'm not sure that there was written</p> <p>25 criteria, although there was ongoing conversations 04:18PM</p>

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<p>1 about, you know, trying to identify what the most 2 significant sources were and --</p> <p>3 Q Well, sir, I'm short on time. I just need to 4 know if you had a written criteria. If you did 5 something else, that's okay. That's not my 04:18PM 6 question. I only want to know if you had a written 7 criteria.</p> <p>8 A Criteria, I don't believe they were written 9 down. If they were, they were -- would be early in 10 Meagan Smith's report, but my recollection, they 04:18PM 11 weren't written down.</p> <p>12 Q Okay, and you did not use as an input to your 13 model any source that was not included in the mass 14 balance study?</p> <p>15 A Correct. 04:19PM</p> <p>16 Q All right. So if there was an internal source 17 of phosphorus to water, an example might be erosion 18 from deforestation or in-stream mining, et cetera, 19 those were not treated as source inputs to the 20 model? 04:19PM</p> <p>21 MR. GARREN: Object to the form.</p> <p>22 A So what you're describing as internal sources 23 would not have been considered as the mass balances 24 reporting inflows here of phosphorus into the 25 watershed. Based on reports, literature for this 04:19PM</p>	<p>1 of Environmental Quality. Sir, have you ever seen 2 this document?</p> <p>3 A I can't say that I have. Does this document 4 stand alone or are there other pages associated with 5 this? 04:21PM</p> <p>6 Q This is the format in which I've seen it. So 7 if there's some State file and it's with some other 8 document, I can't answer it.</p> <p>9 A I've seen maybe a similar document that was a 10 report regarding septic tanks or septic systems from 04:22PM 11 Oklahoma. So if it was in that report, I probably 12 saw it, but I don't recall, you know, seeing this 13 single page in this format.</p> <p>14 Q All right. The report you referenced 15 yesterday was actually a 1997 study. Do you recall 04:22PM 16 that, the septic tank study?</p> <p>17 A Right.</p> <p>18 Q Okay. Now, there was a gentleman by the name 19 of Robert Huber -- certain about his last name, 20 questionable about his first name -- that testified 04:22PM 21 for the State of Oklahoma. Did you review his 22 deposition?</p> <p>23 A I don't believe I've seen that deposition.</p> <p>24 Q Have you reviewed any reports generated by 25 Oklahoma Department of Environmental Quality with 04:23PM</p>
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<p>1 watershed for the local region my judgment, again, 2 was that mining of gravel is a minor source of 3 erosion.</p> <p>4 Q Sir, I didn't ask you to give me your feedback 5 on them individually. I just wanted a yes or no. 04:20PM 6 Internal sources were not modeled, I believe you 7 answered it no; correct?</p> <p>8 A Internal sources -- well, the internal source 9 I guess that would have been included would have 10 been soil test phosphorus that one would attribute 04:20PM 11 as being internal or background kinds of levels. So 12 from that standpoint, that one would have been 13 included.</p> <p>14 Q Okay. Now, you discussed yesterday the 15 decision not to include septic systems as an input 04:20PM 16 into the model; correct?</p> <p>17 A Correct.</p> <p>18 Q So for purposes of your modeling, the only 19 human waste input that made it into your model is 20 that human waste that went through one of the sewage 04:20PM 21 plants in the watershed?</p> <p>22 A That would be correct.</p> <p>23 Q Let me hand you what I've marked as Exhibit 24 19. It's a document produced to us by the State of 25 Oklahoma labeled as generated by Oklahoma Department 04:21PM</p>	<p>1 regard to complaints in the Illinois River watershed 2 regarding function or malfunction in septic systems?</p> <p>3 A The report that you mentioned from yesterday, 4 was that an OCC report or was that an ODEQ report?</p> <p>5 Q It was a DEQ, so I think that would be 04:23PM 6 responsive to my question.</p> <p>7 A So I did review the DEQ report. '97, is 8 that --</p> <p>9 Q Okay. Anything else?</p> <p>10 A Let me just double check the references a 04:23PM 11 moment.</p> <p>12 Q And when I said reports, I actually meant the 13 inspection reports, as in when an inspector responds 14 to a complaint. That's what I meant by report if I 15 was confusing. 04:23PM</p> <p>16 A Okay. I've not reviewed inspector reports 17 from Oklahoma DEQ.</p> <p>18 Q All right. I'm going to show you -- I'm not 19 going to make it an exhibit unless Rick wants. I'm 20 going to show you the comprehensive basin management 04:24PM 21 plan for the Illinois River basin prepared by 22 Shannon Haugherty, technical writer, water quality 23 division, Conservation Commission from May 1999.</p> <p>24 Have you ever -- the reason I'm not going to put it 25 in the Record is because it's in the Record in a 04:24PM</p>

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<p>1 that term, was that the three gauging stations that</p> <p>2 we've discussed for almost two days; correct?</p> <p>3 A Yes.</p> <p>4 Q Did you ascertain any additional loading into</p> <p>5 the Illinois River-Tenkiller system below those 04:42PM</p> <p>6 gauging stations?</p> <p>7 A I did not.</p> <p>8 Q Are you aware of anyone else doing that?</p> <p>9 A I believe Dr. Wells may have accounted for</p> <p>10 some small additional tributaries that provide some 04:43PM</p> <p>11 inputs into Tenkiller but, you know, to be certain</p> <p>12 on that, you would need to ask Dr. Wells.</p> <p>13 Q Okay. You were not engaged in assessing</p> <p>14 phosphorus contributions from littoral properties</p> <p>15 around the lake or near lake operations or 04:43PM</p> <p>16 activities?</p> <p>17 A No, I was not.</p> <p>18 Q To your knowledge, has any court of law</p> <p>19 accepted the GLEAMS model for purposes of assigning</p> <p>20 liability? 04:43PM</p> <p>21 MR. GARREN: Object to form.</p> <p>22 A I'm not aware of any, but I wouldn't be in a</p> <p>23 position to necessarily be aware that that's been</p> <p>24 done or hasn't been done.</p> <p>25 Q All right. The land use land cover data that 04:44PM</p>	<p>1 modeling?</p> <p>2 A They would not be directly represented, but</p> <p>3 they would be represented in that the model was</p> <p>4 calibrated to match observed phosphorus loads. So</p> <p>5 as a result of that calibration, in order to match 04:45PM</p> <p>6 the observed data in that best management practices</p> <p>7 were in place, they get implicitly represented.</p> <p>8 Q Did you quantify the effects of any BMPs</p> <p>9 present or being employed in the Illinois River</p> <p>10 watershed? 04:45PM</p> <p>11 MR. GARREN: Object to form.</p> <p>12 A Let me break that down just a bit. It's going</p> <p>13 to take a couple of responses I think to address</p> <p>14 that. So in the calibration process and in runs</p> <p>15 that did not include representation of stream 04:46PM</p> <p>16 buffers, in that set of cases, best management</p> <p>17 practices were not explicitly considered, nor was</p> <p>18 there a reason to do that for that set of model runs</p> <p>19 and during model calibration.</p> <p>20 If you recall, there was a set of model runs 04:46PM</p> <p>21 in which buffers were represented along streams of</p> <p>22 varying sizes. I believe there were a couple of</p> <p>23 those runs. So in that particular case,</p> <p>24 hypothetical best management practices were</p> <p>25 represented. 04:46PM</p>
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<p>1 you employed, was that data that was derived by</p> <p>2 remote sensing?</p> <p>3 A The land use land cover data would have been,</p> <p>4 yes.</p> <p>5 Q All right. Was there any ground truthing 04:44PM</p> <p>6 done?</p> <p>7 A The agency that prepared this would have done</p> <p>8 some ground truthing, yes.</p> <p>9 Q Were you provided the ground truthing</p> <p>10 information with the dataset? 04:44PM</p> <p>11 A No, I was not and, you know, I don't know that</p> <p>12 it's available with the dataset.</p> <p>13 Q So you haven't seen any ground truthing data</p> <p>14 associated with the land use land cover data; is</p> <p>15 that correct? 04:44PM</p> <p>16 A Correct.</p> <p>17 Q Did you or anyone on your behalf as part of</p> <p>18 this project do any type of accuracy assessment with</p> <p>19 regard to the land use land cover data?</p> <p>20 MR. GARREN: Object to form. 04:44PM</p> <p>21 A No, we did not.</p> <p>22 Q You know what best management practices or</p> <p>23 BMPs are certainly?</p> <p>24 A Yes.</p> <p>25 Q Were BMPs directly represented in your 04:45PM</p>	<p>1 Q All right. You answered some questions Mr.</p> <p>2 George posed about sensitivity analysis. You</p> <p>3 certainly understand the terminology?</p> <p>4 A Correct.</p> <p>5 Q All right. Did you vary the soil phosphorus 04:46PM</p> <p>6 inputs to the model to test its effect on the</p> <p>7 output?</p> <p>8 A Those were, as I recall, let me double check,</p> <p>9 in Appendix D. So one of the parameters that was</p> <p>10 calibrated represents the labile phosphorus 04:47PM</p> <p>11 concentration in the soil. So -- so as a result of</p> <p>12 the calibration process, the starting values were</p> <p>13 adjusted to identify a set of values that would best</p> <p>14 represent, best reproduce the phosphorus loads in</p> <p>15 the calibration period. So in that that would 04:48PM</p> <p>16 represent a sensitivity analysis, those were</p> <p>17 adjusted.</p> <p>18 Q Did you adjust the soil phosphorus inputs in</p> <p>19 order to gauge how sensitive the model was to those</p> <p>20 changes? 04:48PM</p> <p>21 A I guess, you know, I didn't do that. The</p> <p>22 calibration process made those adjustments.</p> <p>23 Q But a sensitivity analysis is a different</p> <p>24 process from a calibration; you agree?</p> <p>25 A Yes, it often would be, but it could be part 04:48PM</p>

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1 of the same.  
 2 Q Okay, but you testified earlier to Mr. George,  
 3 didn't you, that in this modeling exercise, you  
 4 didn't do sensitivity analysis?  
 5 A Sensitivity analysis unique to the IRW was not 04:48PM  
 6 done. Certainly I've done sensitivity analysis with  
 7 this in a range of other soil phosphorus conditions.  
 8 Q Well, okay. You answered the question with  
 9 regard to this specific modeling exercise, there was  
 10 not a sensitivity analysis? 04:49PM  
 11 A No, there was not for this specific effort.  
 12 MR. McDANIEL: I'll pass the witness.  
 13 DIRECT EXAMINATION  
 14 BY MR. ELROD:  
 15 Q Dr. Engel, my name is John Elrod. I think 04:49PM  
 16 we've met before, have we not, sir?  
 17 A Yes.  
 18 Q I'll start by asking you a few questions about  
 19 Dr. Ji-Hong. How long have you known him?  
 20 A Let's see. I believe he joined my group. 04:49PM  
 21 Q Which means what?  
 22 A I'm sorry. He joined my research group in --  
 23 sometime in 2006, I believe, and I guess I had met  
 24 him and knew of him probably six months or so prior  
 25 to that, so that may move back into the 2005 period. 04:50PM

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1 Q He's a South Korean national?  
 2 A Yes.  
 3 Q And if we were to question him, would it be  
 4 necessary for us to use an interpreter?  
 5 MR. GARREN: Object to form. 04:50PM  
 6 A Boy, that's probably outside my expertise a  
 7 bit. So, you know, his communication skills are  
 8 okay. They're not -- you know, they're certainly  
 9 not of a native English speaker, and so I'm not sure  
 10 I can fully address that question. 04:51PM  
 11 Q Is he difficult to understand?  
 12 A Can be.  
 13 Q How old is he?  
 14 A I believe in his mid to late 20s.  
 15 Q And where did he get his doctorate? 04:51PM  
 16 A Without reviewing his CV, I don't recall the  
 17 specific university. It was a South Korean  
 18 university.  
 19 Q Was he in terms of what at least I would call  
 20 a bachelors degree, a masters degree and a doctorate 04:51PM  
 21 degree, were all of those educational activities of  
 22 Dr. Ji-Hong in South Korea?  
 23 A Yes, they were.  
 24 Q When he came to the United States, did he  
 25 first come to Purdue University; is that where he 04:51PM

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1 came to?  
 2 A Yes, correct.  
 3 Q And that would have been in 2005?  
 4 A I believe it was 2005 or '6.  
 5 Q Why did he come to Purdue? 04:52PM  
 6 A He came to be part of the research group that  
 7 I work with to conduct research on a variety of  
 8 hydrologic water quality modeling and related kinds  
 9 of issues.  
 10 Q And if Dr. Ji-Hong were here in this room and 04:52PM  
 11 I said to him, Dr. Ji-Hong, what are you, what do  
 12 you do for a living, what would his response be?  
 13 MR. GARREN: Object to form.  
 14 A Currently he's an assistant professor at  
 15 Andong University in South Korea. 04:52PM  
 16 Q Were you able to find his contact information?  
 17 A I've not had a chance to find that.  
 18 Q You're going to diligently look for that when  
 19 you return home; is that true?  
 20 A I will look for that. 04:52PM  
 21 Q And so if I asked him what he did for a  
 22 living, would he say he was a hydrologist?  
 23 A Yes, yes. He would -- that would be one of  
 24 the terms he would use.  
 25 Q Did you recruit him or did somebody from 04:53PM

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1 Purdue recruit him to come to the United States?  
 2 A I recruited him.  
 3 Q How did you find out that he existed?  
 4 A That would have been through some other  
 5 colleagues in South Korea. 04:53PM  
 6 Q Did you specifically search him out or were  
 7 you looking for -- were there a number of candidates  
 8 for this job?  
 9 A I was looking for someone to join the group to  
 10 be involved in a group of projects. So, you know, 04:53PM  
 11 he was one of probably five or six that I  
 12 considered.  
 13 Q And was he the only one of those five or six  
 14 that you actually asked to come join you?  
 15 A Yes. 04:53PM  
 16 Q What were the group of projects?  
 17 A One of the initial -- so he's been involved in  
 18 several projects. One of the initial projects was  
 19 in some work with HSPF and phosphorus routing.  
 20 There was another effort with urban runoff and 04:54PM  
 21 trying to identify regional values for a group of  
 22 models that would improve the general ability to  
 23 predict runoff without having to calibrate that  
 24 model for each and every location. There was  
 25 another effort in which he added a base flow 04:54PM

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<p>1 component to the L-THIA model. So that's a model  2 that estimates runoff and non-point source pollution  3 from urban areas, among other areas. So when one  4 would apply that, often there may be areas that are  5 non-urban within a watershed potentially, too, to 04:55PM  6 which it's applied, and one of the challenges with  7 some types of pollutants is trying to best  8 characterize those, and the challenge is during low  9 flows. During base flow, you know, the pollutants  10 are different. The way they are transported is 04:55PM  11 different. This model didn't characterize base  12 flow, and so he came up with a very innovative  13 technique that allowed us to calibrate from observed  14 data a group of coefficients associated with an  15 equation to calculate base flow. 04:55PM  16 Q Who were the sponsors or clients for these  17 projects?  18 A So the different projects would have had  19 different sponsors and clients. So as I recall, the  20 last project I was speaking about, this base flow 04:56PM  21 piece, was an effort that we were working on from US  22 EPA, so that -- the Environmental Protection Agency.  23 The regionalization of parameters to go into models  24 to improve runoff calculations without calibration,  25 that would have been a U.S. Department of 04:56PM</p>	<p>1 MR. GARREN: Object to form.  2 A I don't think any of these would.  3 MR. ELROD: I'm going to make a request for  4 whatever that body of work is.  5 Q How would we describe it? 04:58PM  6 A It would be --  7 Q Everything he's worked on while at Purdue.  8 A Sure. It would be a series of draft reports.  9 Q Can we call them the Ji-Hong draft reports?  10 A That would probably be an appropriate name. 04:58PM  11 Q Okay. Now, why did he return to South Korea?  12 A He had an opportunity to take a faculty  13 position.  14 Q And does he -- it sounds to me like he has  15 skill sets that you don't have that you needed? 04:58PM  16 MR. GARREN: Object to form.  17 Q Is that true?  18 A Well, I guess -- this is a natural progression  19 of modelers. It's typical that, you know, I did the  20 same things he was doing day in, day out a number of 04:58PM  21 years ago, and as I grew, the size of the research  22 group grew into other responsibilities. You know,  23 then you begin to work with others that have the  24 day-to-day responsibility for the kinds of things he  25 was doing. So this is, you know, a typical process 04:59PM</p>
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<p>1 Agriculture project.  2 Q How can I get my hands on the pieces of paper  3 that were generated?  4 A So there would be a variety of things that are  5 in draft form at this stage, so I'm trying to 04:57PM  6 recall. I don't believe any of those have moved  7 into -- all the way through a peer-reviewed  8 publication process yet.  9 Q Are you the chief investigator for each of  10 those? 04:57PM  11 A Yes.  12 Q Would we be violating any of the rules under  13 which you work if we were able to get your work in  14 progress for those projects and see what he actually  15 did? 04:57PM  16 MR. GARREN: Object to form.  17 Q Is there any reason why we can't get those  18 things?  19 MR. GARREN: Object to form.  20 A Probably no reason that you couldn't. I guess 04:57PM  21 I would want to confer with Mr. Garren as to, you  22 know, whether that's permitted.  23 Q I mean, the project sponsors or the grants  24 under which you work would have no prohibition on  25 draft reports being handed to outside third parties? 04:57PM</p>	<p>1 in which, you know, a professor manages a research  2 group, interacts with a research group and, you  3 know, the day-to-day responsibilities for these  4 efforts are with post docs, with graduate students,  5 with research associates, with others that are part 04:59PM  6 of that group and others that that group might  7 collaborate with.  8 Q So does he have skill sets that you don't  9 have?  10 A He would -- 04:59PM  11 MR. GARREN: Object to form.  12 A He would certainly have some skill sets that I  13 would be hard pressed to be as efficient at today as  14 he might be, so things like programming, for  15 example. 05:00PM  16 Q Okay. What is programming?  17 A So programming would be writing of a language  18 or code that a computer could interpret to do some  19 series of things, and so an example I guess in the  20 case at hand here was that a program was written by 05:00PM  21 Dr. Ji-Hong to do -- to automate the majority of the  22 calibration process.  23 Q In this case?  24 A In this case. So that's an example of a  25 program. 05:00PM</p>

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1 Q And he began working on this case during what  
2 month and what year approximately?  
3 A So this would have been probably August, the  
4 August sort of time frame, August, September time  
5 frame in 2007. 05:01PM  
6 Q And he left for South Korea when?  
7 A Late January, early February 2008.  
8 Q So he was working on this project for  
9 approximately four to five months?  
10 A That would be correct. 05:01PM  
11 Q Was that the only thing he was doing during  
12 that period of time?  
13 A No.  
14 Q What percentage of his time was dedicated to  
15 this project during that time? 05:01PM  
16 A This would be an approximation, so I would --  
17 it would hard to pin a specific percentage on this.  
18 It would be on the order of -- probably on the order  
19 of 50 percent.  
20 Q Then what was the status of his work product 05:01PM  
21 when he left for South Korea in terms of percentage  
22 of completion?  
23 A Percentage of completion? Well, if we want to  
24 just talk about how many additional months it took  
25 to complete that, that might be the easiest way to 05:02PM

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1 think about it. So, you know, there was continued  
2 work on this through the production of the report in  
3 May of 2008. So it would be tough to assign a  
4 specific percentage as to how much was complete at  
5 that point in time. 05:02PM  
6 Q So from January to May he was in South Korea  
7 completing the work?  
8 A Among other things.  
9 Q And you and he were communicating during that  
10 period of time? 05:02PM  
11 A Yes.  
12 Q By what means?  
13 A Typically by phone and by Skype.  
14 Q Skype is an ability to speak over a computer?  
15 A Correct. 05:02PM  
16 Q No E-mails?  
17 A I don't believe there were.  
18 Q Why not E-mails?  
19 A It was easiest to have a dialogue about the  
20 things that were being done and to make those -- to 05:03PM  
21 take care of those in dialogues.  
22 Q Now, after your May report was issued -- by  
23 the way, at the time your May report was issued, you  
24 had been working on this project for about three  
25 years; is that true? 05:03PM

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1 A So from late summer or summer 2005 until May  
2 2008.  
3 Q And when you issued your May 2008 report to  
4 the court, you certified that over your signature as  
5 being true and accurate, did you not, sir? 05:03PM  
6 A Correct.  
7 Q And it was not true and accurate, was it?  
8 A Subsequently a mistake was identified and  
9 corrected.  
10 Q And was that the mistake the mistake of Dr. 05:03PM  
11 Ji-Hong or was that your mistake?  
12 A Probably -- so Dr. Ji-Hong made a mistake in  
13 the calibration piece of code. That code didn't  
14 step through enough of the response units during the  
15 calibration process, and so it incorrectly assigned 05:04PM  
16 phosphorus to too few of the response units. So  
17 that mistake was Dr. Ji-Hong's.  
18 Q Was he embarrassed by that?  
19 MR. GARREN: Object to form.  
20 A I'm not sure. I would assume he might have 05:04PM  
21 been.  
22 Q Well, did you and he talk about it?  
23 A Yes, we did.  
24 Q And did he express embarrassment to you?  
25 A Yes, he did. 05:04PM

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1 MR. ELROD: Do we have permission to  
2 contact him, Rick, directly?  
3 MR. GARREN: I don't know how to get ahold  
4 of him yet, so I don't know how to answer that.  
5 MR. ELROD: Is he a consultant of the 05:04PM  
6 State? I mean, I'm concerned about the ethical  
7 issue.  
8 MR. GARREN: No. Dr. Engel is ours.  
9 MR. ELROD: So we're free to contact Dr.  
10 Ji-Hong? 05:05PM  
11 MR. GARREN: I'm not saying that. I don't  
12 have an answer for you, John.  
13 MR. ELROD: Okay. Are we going to get one?  
14 MR. GARREN: Yeah.  
15 MR. ELROD: Let's go ahead and change 05:05PM  
16 tapes. I'll be through in about ten minutes.  
17 VIDEOGRAPHER: We're now off the Record.  
18 The time is 5:05 p.m.  
19 (Following a short recess at 5:05 p.m.,  
20 proceedings continued on the Record at 5:21 p.m.) 05:20PM  
21 VIDEOGRAPHER: We are back on the Record.  
22 The time is 5:21 p.m.  
23 Q Dr. Engel, I'd like for you to help me  
24 understand something that's in your original report,  
25 and I want to look at Page 25, Table 5.3, and Page 05:21PM

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